**IBM Global Services**

# *General Safety Course-2003*

*Workbook*

This workbook is intended for use by service representatives and field managers enrolled in the General Safety Course-2003.

**Tenth Edition (January 2003) (1.2)**

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## Notices

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# About This Workbook

The *IBM General Safety Course* is one of a wide range of programs IBM uses to promote and ensure the well-being of its employees around the world. This course introduces the latest safety standards furnished by IBM Global Occupational Health Services.

The audience for this course is service representatives who service IBM and other equipment manufacturer (OEM) hardware throughout the world. Field managers are also included in the audience for this course. Country-specific information can be found in the appendixes at the back of this workbook.

This course explains how to apply correct safety procedures and practices. It tells how to work in environments influenced by electricity, chemicals, and noise. It describes how to work safely and how to prepare for emergencies. It also outlines the procedure for promptly reporting product safety incidents and accidents and near-misses so they can be investigated and corrected.

## Organization of This Workbook

Information in this workbook is organized in the following modules:

- Module 1 discusses ergonomics and working comfortably and efficiently.
- Module 2 discusses electrical safety considerations and responding to electrical injuries.
- Module 3 discusses IBM product safety standards and minimizing potential product safety hazards.
- Module 4 discusses the health effects of exposures to chemicals and excessive noise.

- Module 5 discusses practicing safe work habits, including wearing personal protective equipment.
- Module 6 discusses responding to emergency situations and reporting injuries and illnesses.
- Module 7 discusses environmental concerns regarding battery disposal, PCB handling, and transporting dangerous goods.
- The Glossary contains definitions of terms used in this workbook.
- Appendices contain country-specific information and information that reinforces or illustrates the material in the modules.
  - Appendix A shows product certification marks and hazardous chemical labels for the United States and Canada.
  - Appendix B provides additional safety information for Canada. The information in this appendix is mandatory reading for Canadian service representatives.
  - Appendix C provides additional safety information for the United States.
  - Appendix D contains information about the health effects of chemical exposure.
  - Appendix E lists sources of additional information about health and safety.

## Materials Required to Take This Course

To complete the *IBM General Safety Course-2003*, you need:

- *IBM General Safety Course-2003* workbook

- *Electrical Safety for IBM Services Representatives* handbook, S229-8124-07, or equivalent documentation for your country
  http://trgweb.atlanta.ibm.com/courses/SAFETY/elecsafe.pdf

- *IBM North American Field Operations Well-being Guide*
  http://9.9.182.15/courses/SAFETY/NAFOWbG_1.pdf

- Ergonomics Training Videos on CD-ROM in Canada (order via the IBM Publications Center at http://ibm.com/shop/publications/order or in Canada thru IBMPUBS on VM)

  – "Ergonomics for Remote & Mobile Workers," Part No. GK3T-3533-00
  – "Prevention of Back Injuries," Part No. GK3T-3533-00
  – In the US, through Publications

  http://w3.ehone.ibm.com/public/applications/publications/cgibin/pbi.cgi

## How to Take the End-of-Course Test

Once you understand the material in the course, you must pass its associated test to get course completion credit. You may take the test in one of two ways:

1. **US ITS Employees Only** Go to the ITS Skills and Development web site at

   http://trgweb.atlanta.ibm.com/

   a. In the left column, Click **Online Tests**,
   b. Enter your Serial Number and Name, then click **Continue**
   c. Select the **IBM General Safety Course - 2003 Quiz**

2. **Other Employees** Go to the IBM Global Campus web site and sign in with your intranet password:

a. In the left column, Click **Student Center**
b. Find the appropriate **course number**, and in the **Actions** column click **Start/Resume Course**.
c. Scroll down and click the link to the **course test link**.
d. Select the link to the version of the test you are required to take (All countries except Canada, Canadian or French Canadian). The test is administered from a website that requires you to enter serial number and location for verification via the IBM Blue Pages.

The test has multiple choice questions. You must score 80% to pass. Review any missed questions in the course material and then take the test again as needed. When you pass the test, your completion record is processed to update your training history. In North America, if you need help with taking the test, call the IBM Global Campus Help Desk at 1-888-363-2885. In EMEA, call your local help desk and select option 3.

## Conventions Used in This Workbook

The *IBM General Safety Course—2003* uses the following conventions:

- **Bold type** is used to mark items in lists and column headings. It is also used for command names.
- *Italic type* is used for a word that deserves special emphasis.
- The following icons are used in this workbook:

This icon indicates the learning objectives for each lesson.

This icon indicates the review questions for each lesson.

This icon indicates recommended reading selections in safety manuals.

This icon indicates a hazard alert.

# Module 1. Ergonomics


This module discusses ergonomics, which is an applied science that studies the design and arrangement of things that people use so that people and things interact more efficiently and safely. If you perform tasks without considering proper ergonomics, you usually experience, over time, physical pain and discomfort. The lessons in this module explain how to minimize risks, prevent injuries, and how to practice ergonomics at work and at home.

The lessons in this module are:

| | |
|---|---|
| Lesson 1 | Back Safety |
| Lesson 2. | Workplace Organization |
| Lesson 3. | Mobile Computing |

## Lesson 1. Back Safety


Most people will have a back injury or suffer with back pain in their lifetime. Back injuries can range from an uncomfortable and inconvenient strain or sprain to a severely painful and debilitating ruptured disc in the vertebral column. Back problems can last a lifetime, so it is important to understand how they occur and how to prevent them. This lesson provides tips and techniques to help you practice back care safety.

### Objectives

After completing this lesson, you should be able to:

- Identify safe lifting techniques
- Identify practices that promote a healthy back

### View the Video

**Stop!**
View the *Prevention of Back Injuries* videotape and then continue with the course. It can be obtained through the IBM Publications Center at
http://ibm.com/shop/publications/order

or viewed on the web at
http://w3.ehone.ibm.com/public/applications/publications/cgibin/pbi.cgi

In addition, please view the following URLs:

1) All Countries
http://w3-1.ibm.com/hr/us/ohs/gohsweb.nsf/pages/healthyback.htm

2) In Canada at
http://w3.can.ibm.com/ohs/ergonomics

## Avoiding Back Injuries

Service representatives perform a number of job activities that can cause a back injury. Non-work-related activities can also cause back injuries. The potential for back injury increases significantly when you perform a task improperly. Injuries can occur from one improperly executed movement or from the cumulative result of handling materials improperly for many years.

Tasks that involve an increased potential for back injury include, but are not limited to:

- Lifting tools and parts in and out of automobiles
- Picking up, carrying, and setting down small systems and heavy boxes
- Laying cables
- Maintaining awkward positions while you service equipment
- Lifting monitors

You can avoid a back injury by following good safety practices, exercising, and using proper lifting techniques.

## Safe Lifting Techniques

Many back injuries result from improper lifting. Table 1-1 on page 1-3 shows basic safety techniques to use when you lift objects.

Table 1-1. *Safe Lifting Techniques*

| Guideline | Technique |
|---|---|
| Plan the lift | Visualize the path and remove any obstructions or slip hazards. |
| Get a firm footing | Distribute the stress evenly on each side of your spine to prevent twisting. |
| Test the weight | Rotate the load onto a corner to estimate its weight before you lift |
| Keep your back straight | Keep your back in its natural alignment from head to seat, so your thighs and arms, not your back, absorb the strain |
| Keep the load close | Do not try to pick up an object that is an arm's length from the body. The closer the load is to your spine, the less force it exerts on your lower back as you lift it. When you remove objects from a car, pull or slide them as close to you as possible (with the back in neutral alignment) before you lift them. |
| Lift with your legs | Use a smooth, easy motion and let your leg muscles, not your back muscles, which are weaker, do the work. Do not jerk the load. |
| Do not twist your body | Turn your entire body, including the feet, when you lift or carry something. Pull the item into your body before you turn |
| Get help | Ask someone for help or use a mechanical aid when a load is too heavy, too large, or unmanageable. When two people carry a load, they should carry it at the same level. One person should direct and call the signals |
| Push, do not pull, a load | Push, do not pull, a load that you need to roll or slide along a surface. |
| See the path | Never carry a load that blocks your vision. |
| Straddle small items | If an item is small enough, try to straddle it before you lift. Place one foot slightly ahead of the other. |
| Create a crutch | When you lift with one hand, place your other hand on an adjacent object or on your thigh to create a crutch. |

## Material-Handling Criteria

IBM designs machines, assemblies, and components to minimize injuries that can occur during moving, packing, unpacking, removing, or handling. During the design phase, IBM considers the human factors, characteristics of the affected population, and the following product features:

- Product weight
- Product height
- Product accessibility
- Product position
- Product motion distance and frequency

You should ask for assistance or use mechanical aids when you attempt to move objects that weigh more than 16 kg (35 lb).

Caution labels appear on all IBM products to indicate weight hazards. Table 1-2 shows recommended weight criteria for safe lifting.

Table 1-2. *Material-Handling Criteria*

| Weight Criteria | Requirements |
|---|---|
| From 18 kg (39.7 lb) to 32 kg (70.5 lb) | Objects in this range should be handled by two or more persons. |
| Above 32 kg (70.5 lb) to 55 kg (121.2 lb) | Objects in this range should be handled by three or more persons |
| Above 55 kg (121.2 lb) to 100 kg (220 lb) | Material-handling systems (levers, slings, and lifts) must be used. When this is not practical, specially trained persons or services like riggers or movers must be used. |
| Above 100 kg (220 lb) | Material-handling systems (levers, slings, lifts) must be used. When this is not practical, specially trained persons or services (riggers or movers) must be used. |

## Tips for a Healthy Back

When you service equipment, you must often work in awkward positions that increase stress and strain on your back and leave it prone to injury. You should make the following tips part of your daily work habits:

- Bend your knees whenever possible to relieve back strain.
- When you work at a low level, avoid bending at the waist while the legs are straight. Sit on something low to the ground to relieve stress on your knees.
- Stretch your muscles and tendons to relieve tightness when you work in prolonged or awkward postures. However, do not stretch your muscles or tendons when they are cold.
- Lifestyle has a significant influence on a healthy back. Table 1-3 contains lifestyle tips for promoting a healthy back.

Table 1-3. *Tips for a Healthy Back*

| Condition | Tip |
|---|---|
| Stress | People often react to stress by tightening muscles, especially in their neck, shoulders, and back. Prepare your muscles before you lift or move a load. Offset the effects of stress-related muscular tension by practicing deep breathing. |
| Posture | Good posture is a function of alignment and balance. Poor posture |

| | |
|---|---|
| | creates undue stress and exertion on your back muscles and increases the chance of injury. Always maintain good posture. |
| Fitness | Perform simple exercises to strengthen your abdomen and back to achieve a reasonable level of back fitness. Staying in shape and maintaining a healthy weight reduces stress on the back. |

## Summary

Back injuries are one of the most common injuries experienced by service representatives. Job tasks that involve lifting and carrying tools, parts, and systems have the greatest potential for causing back injury.

You can avoid back injury by practicing safe lifestyle tips, exercising, and using proper lifting techniques. Ask someone to help you lift objects that weigh more than 16 kg (35 lb). Maintaining good posture and back fitness can reduce stress, strain, and the chance of back injury.

# Lesson 2. Workplace Organization


Good workplace organization saves time and money and helps you work comfortably. This lesson explains how to arrange and adjust your equipment to fit your individual needs. It also provides a checklist to help you evaluate your workplace for effective organization and equipment placement.

## Objectives

After completing this lesson, you should be able to list ergonomic tips for adjusting and positioning your:

- Chair
- Keyboard
- Monitor

## Workplace Comfort and You

Do your muscles occasionally feel stiff and sore throughout the workday?

Do you use one set of muscles to perform the same task repeatedly or to make forceful movements?

You are probably performing tasks without considering ergonomics, thus possibly causing discomfort or persistent pain in your muscles, tendons, and other soft tissues. You can move around and change your work habits to prevent and minimize discomfort. For example, you can trace much of the discomfort associated with using computers to poor workplace organization, improper equipment adjustment, poor posture, and prolonged, uninterrupted work practices.
Tell your manager if you experience any of the following symptoms and believe they are work related:

- Discomfort, stiffness, or pain in your back, neck, shoulders, elbows, forearms, wrists, hands, or fingers
- Tingling, coldness, or numbness in your hands or wrist
- Clumsiness or loss of strength or dexterity in your hands
- Joint or muscle pain when you wake up

- Eye strain
- Headaches

Any of these symptoms might be temporary and have no connection to your work environment. For example, they might result from medical conditions, such as pregnancy, diabetes, or arthritis. Whatever their source, it is important to address these symptoms promptly and seek medical attention. Early intervention is the key to avoiding prolonged discomfort. You may want to consult with Occupational Health Services for further ergonomic consultation or absence due to illness.

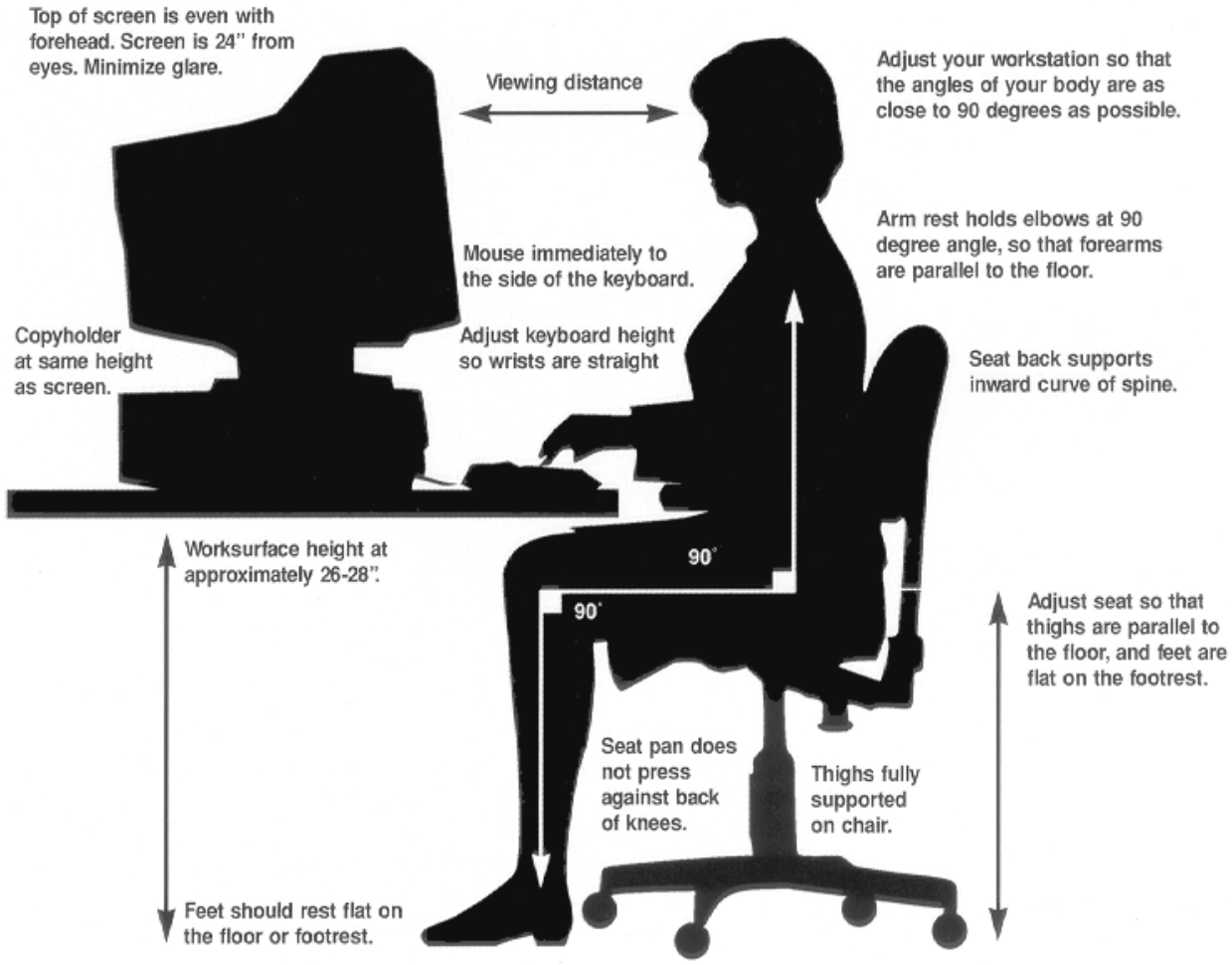
You can maintain good personal health with a program of regular medical and physical examinations, good diet, and exercise. Please review the 'Your Health' section of your country w3 site.

## Ergonomic Tips for Working Comfortably

The key to working comfortably is to organize your workplace to fit your individual needs. Take a few minutes each day to think about the best position for your equipment and the most effective use of your space. Place the things you use regularly, such as a mouse or telephone, within the easiest reach.

You should always perform these ergonomic exercises:

- Take short breaks at least every 20-30 minutes. Leave your desk and move around to circulate the blood and or do office exercise (see w3.can.ibm.com/ohs/ergonomics for office stretches).
- Rest your eyes occasionally throughout the workday.
- Experiment with the position of your chair, keyboard, and monitor to find the arrangement that works best for you.




The following topics present suggestions to help you work in neutral and relaxed positions.

## Chair

A chair is one of the most important items in your workplace. A chair should encourage good posture and circulation and help you avoid discomfort. Select a chair that provides good support for your body, especially your lower back. Adjust your chair to maintain the following positions:

- Adjust the height of the chair so that thighs are parallel to the floor, and feet are flat on the floor or a foot rest.
- Consider using a cushion or back rest if you require more lumbar support.

Stand, stretch, or shift positions in your chair to give your body some relief from sitting at least every 20-30 minutes.

### Keyboard

A keyboard should be comfortable to use. When you use a keyboard, you should consider the keyboard height, your arm position, and your key touch technique. The following conditions exist if your keyboard is positioned correctly:

- Your arms are relaxed and comfortable, and your forearms are roughly horizontal.
- Your shoulders are relaxed, not hunched up.

- Your wrists are extended straight, not bent up or down uncomfortably.
- You use a wrist or palm rest between periods of typing, *not* while you are typing.
- Your hands glide over the keys; hands remaining in a fixed position cause fingers to over-reach for the keys. Use a light touch for typing, keeping your hands and fingers relaxed.
- Your mouse is close to the keyboard so you can use it without stretching or leaning to one side.

### Monitor

You can adjust the brightness, contrast, and position of your monitor. It is a good practice to perform the following tasks:

- Adjust the monitor so that the top of the screen is slightly below eye level for comfortable viewing.
- Position the monitor to minimize glare and reflections from overhead lights, windows, and other sources. Consider closing blinds and turning off some overhead lights.
- Put an antiglare filter on the front of the screen when you cannot avoid reflections or adjust the lighting.
- Position yourself and the monitor to achieve and maintain a comfortable viewing distance, usually about 50 to 60 cm (20 to 24 in.) or a fisted arms length away.
- Keep your head in a neutral comfortable, upright position.
- Set the contrast and brightness of the screen at a comfortable level. As the light in the room changes, adjust the contrast and brightness.
- Clean your screen, antiglare filter, and eyeglasses regularly.
- Consult a vision care specialist if you experience eye fatigue or discomfort.

### Stretching Exercises

The human body is not designed to remain in a stationary position for long periods. You can perform some simple stretching exercises to reduce visual, muscular, and psychological fatigue. Table 1-4 contains some common stretching exercises that you can perform at your work or home office.

- See exercises at **http://w3.can.ibm.com/ohs/ergonomics**

**CAUTION:**
**Stop performing any stretching exercise that causes pain or undue discomfort and consult with your physician before beginning an exercise program.**

Table 1-4. *Stretching Exercises*

| Area | Procedure |
|---|---|
| General | Stand up and stretch your arms over your head |
| Eyes | Rest your eyes by occasionally looking into the distance and then closing your eyes for a few seconds. |
| Neck | Turn your head slowly left and then right for five seconds. Repeat several times |
| Shoulders | Relax your arms at your side and then raise your shoulders, rotating them up and back in a circular motion. Repeat several times |
| Upper back | Sit on a stable chair with your feet flat on the floor. Next, clasp your hands behind your head and slowly arch your back. Hold up to five seconds. |
| Wrists | Hold your hands in front of you and gently rotate your wrists so that the fingertips form circles in the air. Repeat several times. |
| Fingers | Clench your fists for five seconds, and then spread your fingers as far as possible. Hold for five seconds. Relax and repeat several times. |

### Ergonomic Accessories

A variety of accessories can help make you more comfortable and productive when you use a personal computer. Some of the most popular products are:

- Keyboard and mouse wrist rests
- Copy holders
- Keyboard pullout trays
- Antiglare filters

You can obtain most of these products through internal supply, local office supply stores, and catalogs. Check your country ergonomic site for details on purchasing. These products are not a substitute for efficient workplace design, good work practices, and frequent breaks. Shop carefully and try out the products before you buy them. Discuss your purchasing plans with your manager before purchasing items if you are expensing them.

## Workplace Organization Checklist

You can complete the following checklist to evaluate your workplace. Make adjustments for any items that you do not check.

**Maintain a "Neutral" Posture**

- The head should be straight and balanced over the spine while looking forward at the screen. Minimize the flexed or extended neck position.
- Elbows should be bent at approximately 90 degrees when hands are on keyboard.
- Wrists should be in a neutral position, straight with the forearm. If you use a palm rest, it should not be used while actually keying but only in-between periods of keying.
- Feet should rest flat on the floor or a foot rest should be utilized.

**Adjust Your Seat**

- Adjust the height of the chair's seat so that the thighs are horizontal, feet rest flat on the floor, and arms and hands are comfortably positioned at the keyboard.
- Use a foot rest if the chair is too high. This takes pressure off the back of the thighs.
- Adjust the height and tension of the back rest (if applicable) so that it supports the lower back and fits the lower curvature of the spine.
- Seat pans that are tilt adjustable should be positioned for proper slope and comfort.
- Adjust the arms of your chair if applicable. Arms should be at or slightly above resting elbow height.

**Position Your Computer Workstation**

- Position the screen to minimize glare and reflections from overhead lights, windows, and other light sources. Place the screen so that uncovered windows are not directly in front of or behind you when seated.
- Adjust lighting levels by adjusting blinds, taking care to reduce glare, and providing task/indirect lighting were needed.
- Adjust the height of the display so that the top of the screen is slightly below eye level when sitting at the keyboard. The top of the screen should not be above eye level. Direct the screen toward your eyes, taking care to avoid problems with glare.
- Set the contrast or brightness of the screen at a comfortable level. (This may have to be done more than once a day, as the light in the room changes.)

- Position the display about an arm's length away with the hand extended or in the shape of a fist and adjust the size of the characters to avoid eye strain.
- Where it is impossible to avoid reflections or adjust lighting, an anti-glare filter placed over the screen, or a "hood" above or around the screen, can be helpful. Filters may affect the clarity of the image on the screen and should be tried only after other methods of reducing glare have been exhausted.
- If your work is primarily text entry, place the keyboard so that the space between the "G" and "H" keys is directly in front and in the middle of the monitor.
- Place the mouse or trackball immediately to the side of the keyboard and at about the same height.

**Work Smart**

- Organize your work, placing the things you use most regularly (e.g. telephone) within easy reach.
- Position documents adjacent to your monitor and consider rotating to the opposite side to avoid static neck postures.
- Take occasional breaks from work on your VDT and pay attention to signs and symptoms of discomfort. Change positions, stand up and stretch frequently.

Use a soft touch on the keyboard, keeping hands and fingers relaxed, and wrist and body in neutral positions.

## Summary

A well-organized workplace helps you work more comfortably and efficiently. You should organize the equipment on your desk so the things you use most frequently are easy to reach. Adjust your chair, keyboard, and monitor so you can work in a relaxed position. Vary your tasks to prevent fatigue and take periodic breaks to reduce discomfort and stress.

If you experience discomfort or pain in muscles, tendons, or other soft tissues, seek medical attention. Symptoms might include discomfort, stiffness, or pain in the back, neck, shoulders, elbows, forearms, wrists, hands, or fingers.

# Lesson 3. Mobile Computing


Mobile professionals take their office with them and perform job tasks on the road with a ThinkPad computer. This lesson provides ergonomic tips for mobile computing and specific instructions for working in cars, airplanes, and hotels.

## Objectives

After completing this lesson, you should be able to identify the ergonomic positions for working with a ThinkPad.

## View the Video

### Stop!

View the *Ergonomics for Remote & Mobile Workers* videotape and then continue with the course. It can be obtained through the IBM Publications Center at http://ibm.com/shop/publications/order, in Canada through IBMPUBS on VM (Part No. GK3T-3533-00) or viewed on the web at:

http://w3-1.ibm.com/hr/us/ohs/gohsweb.nsf/pages/ergotrain.htm

## Ergonomic Tips for Mobile Computing

Ergonomics also applies to mobile computing. The following ergonomic tips can help you avoid discomfort when you use a ThinkPad in your work or home office.

- If you are using your ThinkPad as your primary workstation for long periods, you should consider using a keyboard, mouse and screen riser.
- Your eye level should be at the top 1/3 of the screen when using a screen riser
- Take frequent rest breaks and listen to your body when you experience the first signs and symptoms of discomfort.

Table 1-5 contains some rules of the road, which are ergonomic tips for specific mobile computing environments.

Table 1-5. *Mobile Computing Rules of the Road*

| Environment | Rule |
|---|---|
| Meeting room | Adjust your chair height so your elbows are slightly higher than the table top. If a table is not available, place the ThinkPad on your briefcase. |
| Car | **Warning: Never operate a ThinkPad while you are driving.** If you must use a ThinkPad in a car, pull over to the roadside and move to the passenger seat. Place the ThinkPad on your briefcase or some other flat surface. |
| Airplane | Choose a bulkhead seat or an exit row seat for additional space. |
| Hotel room | Choose a hotel with a business center or one with rooms with desks and data ports. You can use a rolled-up bath towel or pillow to support the lumbar (lower) region of your back. You can also use a bath towel or pillow as a padded seat cushion. You should not use a ThinkPad in bed, but if you must, maintain good posture and support the lumbar region of your back. Sit up straight to avoid neck, shoulder, and back discomfort. Use pillows to support your lower back and head. |

### Carrying a ThinkPad

ThinkPad computers weigh 1 to 2 kg (3 to 5 lb). Holding or carrying a ThinkPad for an extended period of time can affect your posture. When you travel, remember to:

- Shift the ThinkPad between hands and shoulders frequently to provide mini-rests for each side of your body.
- Balance a load of baggage and a ThinkPad on both sides of your body.
- Consider using a bookpack, backpack or rolling carrier to carry your ThinkPad.

## Summary

When you are on the road, working with a ThinkPad computer can be a challenge. You should practice the ergonomic rules of the road to relax and maintain your productivity.

Frequent work breaks are especially important in a mobile computing environment. Adjust your chair height in a meeting room so your elbows are slightly higher than the table top. When you must work in a car, park on the roadside, move to the passenger's seat, and place your ThinkPad on a briefcase or other thin, flat object. When you work on an airplane, select a bulkhead seat or an exit row for additional space. When you work in a hotel room, use a rolled-up towel or pillow to support your lower back. You should not use a ThinkPad in bed. When you carry a ThinkPad, shift the weight between your hands and shoulders frequently, and try to balance the load on both sides of your body.

# Module 2. Electrical Safety


Electric shock is the effect of electric current flowing through the human body. Most people have experienced a minor electric shock. However, the conditions that cause a minor electric shock can change slightly and cause serious injury or death. This module discusses electrical safety.

It explains:

- What causes electric shocks
- How electric shocks affect the human body
- How to avoid electric shocks

The lessons in this module are:

Lesson 1. Electrical Injury
Lesson 2. Grounding or Earthing
Lesson 3. Receptacle Safety
Lesson 4. Customer Electrical Power Distribution
Lesson 5. Uninterruptible Power Supply
Lesson 6. Lockout-Tagout

# Lesson 1. Electrical Injury


This lesson discusses electric shock injuries. Electric shock is the effect of electric current flowing through the human body. No matter how minor an electric shock appears, the factors that cause it need to vary only slightly to cause serious injury or death in some circumstances. It is extremely important to know what causes electric shock, the effect it has on the human body, and how to avoid it.

## Objectives

After completing this lesson, you should be able to:

- Identify the factors that affect the degree of injury from electric current
- Identify the correct response to a victim of an electrical injury

## Reaction to Electric Shock

The reactions of the human body to electric shock range from unawareness to breathing cessation. The amount of current that flows through the body affects the threshold of perception, threshold of ventricular fibrillation, and threshold of let-go. Some reactions to electric shock are muscle spasms, loss of consciousness, dizziness, rise in blood pressure, marks on the body, impulse disturbances to the heart, and transient cardiac arrest.

### Threshold of Perception

Your reaction to an electric current can vary from unawareness to serious injury or death. The threshold of perception indicates your reaction to different amounts of electrical current. For example, the threshold of perception is usually very low for an electric current of less than 0.5 milliamperes (mA). Your body would not feel the current or react. However, the threshold of perception can be high for current from 50 Hz or 60 Hz sources in the 0.5 mA to 10 mA range. Your reaction can range from an unpleasant sensation to dizziness.

### Threshold of Ventricular Fibrillation

One of the most serious reactions to electrical current is ventricular fibrillation, or heart paralysis. When a strong electrical current passes through the body, the natural rhythm of the heart is disrupted. The heart muscles contract in a random sequence and the heart cannot pump blood, which carries oxygen to vital organs. Ventricular fibrillation is the main cause of accidental deaths in 50 Hz and 60 Hz installations. The threshold of ventricular fibrillation is the range of conditions that cause ventricular fibrillation from an electric shock. The path and duration of the current flow through the body influence the threshold of ventricular fibrillation. For example, ventricular fibrillation can occur from about 40 mA of current fl owing through the body for three seconds or from about 50 mA for one second.

### Threshold of Let-Go

The threshold of let-go is the range of conditions that prevent you from letting go of the power source during an electric shock. The threshold varies for different persons and environmental conditions, 2-2 General Safety Course-2003 such as the path of the current through the body, the condition of the skin, and the length of time the current passes through the body. Electrical current at 10 mA can prevent you from letting go of the power source.

### Muscle Spasms

Electrical current at 40 mA usually produces muscle spasms, which can cause the following reactions:

- Losing your balance and falling from an elevated position
- Being thrown and striking an object
- Being thrown from one electric shock hazard to another, more hazardous shock hazard

## Electric Shock Injuries

Injuries from electric shock range from skin blisters to death. The most common injuries are electrocution, brain damage, hand and eye injuries, skin blisters, and burns.

### Electrocution

Electrocution is death from an electric shock. Electric shock is the effect of electric current flowing through the human body. An electric shock can cause ventricular fibrillation or breathing disruptions that result in cardiac arrest or asphyxia.

### Brain Damage

When an electric shock causes a person to stop breathing or experience ventricular fibrillation, the brain is usually irreversibly damaged in approximately four minutes. This happens because the brain is the organ most sensitive to oxygen loss.

### Hand and Eye Injuries

A hazardous energy source can cause hand and eye injuries. The energy source can be a battery, a capacitor, or a current produced directly from a power supply or the mains. Even though the

energy source does not generate enough current flow through the body to cause an electric shock, the danger occurs when the energy source is short-circuited by another conductor. The current flow can rapidly volatilize the metal conductor and cause a hand or eye injury.

### Skin Blisters

Tiny blisters can form under the skin if the skin maintains contact with harmful current. These blisters can enlarge very quickly and can rupture or break, which moistens the skin and further reduces the skin's resistance to the current flow. As the skin resistance decreases, current increases even though other factors remain the same. If the current level continues to rise, it can cause ventricular fibrillation.

### Burns

Current above 200 mA usually causes burns, which can be light or severe. Current of several amps usually causes severe burns that can result in death.

## Factors Affecting the Degree of Injury

The human body is a very effective conductor of electric current. You can become part of the current path when you contact an electric power source with any part of your body. When the current is passing through you, several factors determine how the current affects you. These factors vary among individuals and environments. You should never assume that a voltage is safe because it's below a certain value. It is current, not voltage, that causes injury. However, voltage potentials above 42.4V peak (30V RMS) AC, or 50V DC are considered potential shock hazards in environments that contain information technology and telecommunications products.

### Primary Factors

The degree of injury from an electric shock depends on several factors. The most important, or primary, factors are:

- Amount of current passing through the body
- Frequency of the current
- Path of the current through the body
- Length of time the current passes through the body

The human body can conduct current flow that is potentially harmful or fatal. Figure 2-1 shows how current flow spreads out through the body as it travels from one contact point to the other. Electrical current that flows between two small points can damage vital organs. When the contact points are restricted to the arm, the current flows only through that portion of the body.

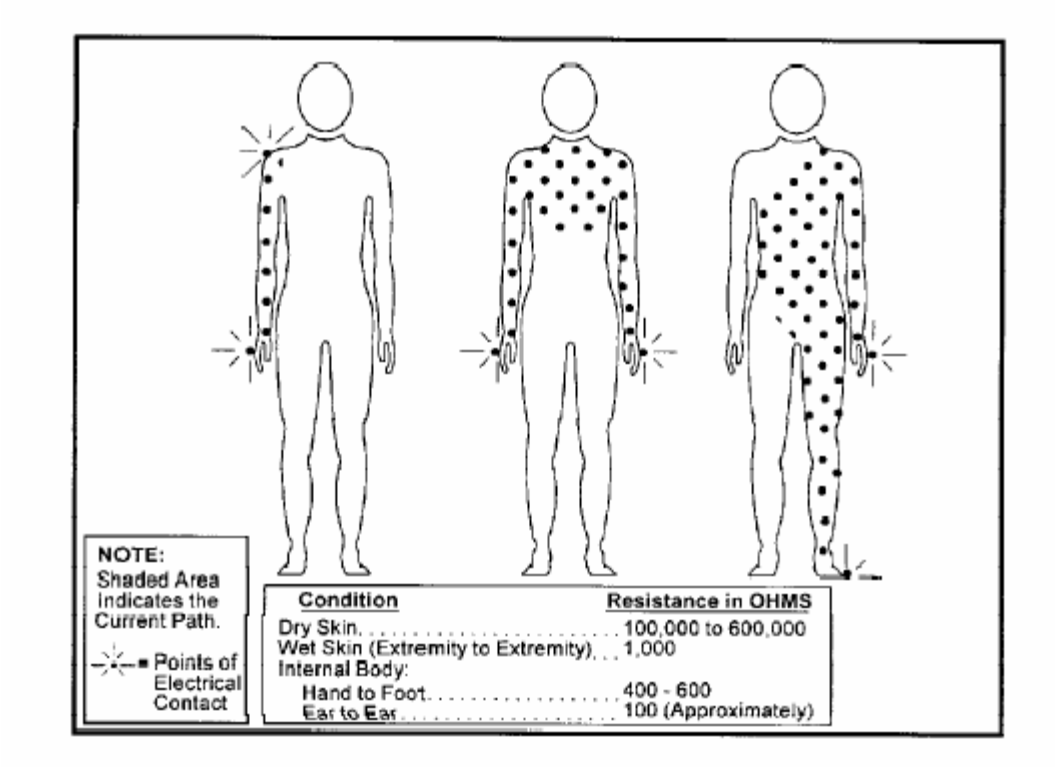



Figure 2-1. *Current Flow through the Body*

### Secondary Factors

The secondary factors that influence the effect of the primary factors are:

- Voltage level of the hazardous source
- Body parts that come into contact with the hazardous source
- Surface area of body contact
- Condition of skin
- Contact pressure
- Moisture or perspiration on the skin

Moisture or perspiration dramatically lowers the skin's resistance to electrical current. For example, the resistance from one moist hand through the body to the other moist hand can be 1,000 ohms. When the skin is dry, the resistance can increase to approximately 100,000 ohms.

Assume that your hands are damp and you come in contact with a 120 V ac source with one hand and an earth (ground) potential with the other. Ohm's Law states that the current is equal to the voltage divided by the resistance. In this example, it equals 120 ÷ 1,000, or 120 milliamperes (mA). This is within the range that causes ventricular fibrillation in half a second. The same conditions produce approximately one mA if your hands are completely dry and the skin intact. You would feel an extremely uncomfortable shock that would not cause serious injuries. However, if you are working in a 230 V ac or 240 V ac environment, the current is approximately 240 mA, which produces a greater shock and more serious injuries.

## Responding to Electrical Injury

Electrical accidents require an immediate, appropriate response. Victims of electrical injury require prompt, professional medical aid.

The correct procedure is to:

- Use caution and act quickly
- Call for emergency assistance
- Administer first aid

### Use Caution and Act Quickly

Be careful when you react to an electric shock emergency. If you do not protect yourself and use caution, you can also become a victim. The correct reactions are:

- Avoid touching a victim of an electrical injury who is still in contact with the electrical current because you can also become a conductor of the current.

- Use the room or system emergency power off (EPO) switch, unit emergency power off (UEPO) switch, or disconnect switch to remove the electric current. The EPO or UEPO switch does not necessarily remove all hazardous potentials from a machine. Refer to the machine maintenance documentation for more information.

- Use a non-conducting object to pull or push the victim away from the electrical equipment if you cannot find the power switch. Prompt action is essential. Each second the victim is in contact with the electrical current increases the injury potential and decreases the chances for survival.

### Call for Emergency Assistance

Call for emergency assistance as quickly as possible. Some sources of emergency first aid are:

- Fire and Emergency Rescue
- Hospital
- Ambulances

Most areas have emergency numbers. You should know your area's emergency number and the emergency procedures for each customer. You should also know the location of emergency numbers and the people to contact in case of an emergency.

### Administer First Aid

Although professional medical assistance is essential, you can perform the following first aid procedures to prevent deterioration of the victim's condition:

1. Make certain that the victim's breathing is unobstructed.
2. Cover the victim with blankets or coats to maintain body temperature and minimize the victim's physiological response to the electrical injury.
3. Do not move the victim unless the victim's current position could cause further harm.
4. Administer cardiopulmonary resuscitation (CPR) if the victim is not breathing. Do not administer CPR or any other first aid procedure if you are uncertified or uncertain about what to do.

## Summary

This lesson discussed the reactions to electric shock, the injuries from electric shock, and the correct emergency responses for a victim of electric shock. The most serious reactions to electric shock are ventricular fibrillation, inability to let go of the power source, and breathing cessation. The most serious electric shock injuries are death, brain damage, and severe burns.

The correct responses to a victim who is experiencing electric shock are:

- Act quickly.
- Be cautious and disconnect the power source.
- Call an emergency assistance service.
- Administer cardiopulmonary resuscitation (CPR) or other first aid procedure only if you are certified and know exactly what to do.

# Lesson 2. Grounding or Earthing


This lesson explains the purpose of grounding (earthing) equipment and presents the definitions of grounding and earthing terms. It also describes the various electrical distribution systems and presents grounding (earthing) safety rules.

## Objectives

After completing this lesson, you should be able to:

- Distinguish between the terms *ground* (*earth*), *grounding conductor* (*earthing conductor*), *grounded*, (*earthed*), and neutral
- List three grounding (earthing) safety rules

## Purpose of Grounding

The primary reason for connecting ground (or earth) to equipment is personal safety. Protective grounding (or protective earthing) of equipment provides a direct path to earth or to some other conducting body that serves in place of earth. This practice diverts potentially harmful fault-currents away from people and allows operation of protective devices, such as fuses or circuit breakers.

**Note:** In many countries, *ground* is referred to as *earth*. The two terms are used synonymously in this course.

National or local codes define the standards for grounding, grounding conductors, and neutral conductors.

Table 2-1 lists grounding terms. These terms are similar but, they are not interchangeable. For example, do not use the term *grounding* wire when you mean *ground* wire.

Table 2-1. *Definitions of Grounding Terms*

| Term | Definition |
|---|---|
| Ground or Earth | Ground, or earth, is the conducting mass of earth, or the conducting body that serves in place of earth, that is at zero potential for electric shock or other safety hazard. The connection between the ground and electrical equipment must be intentional. An unintentional ground presents a safety hazard. |
| Grounding Conductor or | The grounding conductor is any conductor, other than the neutral conductor, that connects the machine frame or other non-current-carrying conductive |

| | |
|---|---|
| Protective Earthing Conductor | parts to the circuit grounded conductor at the service entrance. The grounding conductor is also referred to as the safety ground or the equipment ground. In many countries it is called the protective earth conductor. |
| Grounded or Earthed | “Grounded” refers to any current-carrying conductor that is intentionally connected to ground. Sometimes the neutral conductor in primary circuits is called the grounded neutral conductor or, in some countries, the earthed neutral conductor. |
| Neutral | Neutral is the return path in a power distribution system. It carries the entire current of a single-phase circuit or the resultant current of an unbalanced three-phase circuit. |

## Electrical Distribution Systems

All electrical distribution systems have energized or current-carrying conductors that connect the source to the load. They can also have neutral conductors that provide the return path from the load to the source of electrical energy.

Many electrical wiring codes require joining the neutral conductor and the grounding conductor (protective earth conductor) at the source. The source can be at the entrance of the electrical service into a building or at the secondary of a main distribution system transformer. The codes prohibit joining these conductors at any other point. For example, it is prohibited to connect the neutral conductor to the grounding conductor within user equipment.

Distribution system neutrals or returns are connected to earth or ground through an impedance. The value of the impedance can vary from “short circuit” or “zero” impedance. Table 2-2 summarizes the characteristics of each system. The local codes and controlling authorities govern the choice of a grounded, floating, or impedant neutral system for a particular installation. General Safety Course-2003 recommends grounded, neutral distribution systems for its computer equipment. If you encounter an ungrounded or impedant neutral system, notify management for assistance. A floating power distribution is not necessarily unsafe; however, you should still notify management.

Table 2-2. *Types of Neutral Grounding*

| **System Property** | **Grounded** | **Impedance Grounded** | **Floating** |
|---|---|---|---|
| Immediate shutdown of faulty circuit on occurrence of first ground fault | Yes | No | No |
| Control of transient overvoltages due to arcing around faults | Yes | Yes | No |
| Control of impressed or self-generated steady state overvoltages | Yes | No | No |
| Flash hazard to personnel during ground fault (with no escalation) | Severe | Essentially zero | Essentially zero |
| Arcing fault, damage to equipment during ground fault (with no escalation) | Severe unless fault is removed promptly | Minor unless prolonged fault removal causes escalation | Minor but transient overvoltages can cause fault escalation or multiple insulation failures |
| Shock hazard, unfaulted phases to ground potential during ground fault on one Phase | Line-to-neutral voltage | Approximately line-to-line voltage | Can be several times line-to-line voltage |

| | | | |
|---|---|---|---|
| Shock hazard, equipment frame to ground during solid internal line-to-ground Fault | Small | Small | Small |
| Detection of arcing faults | Line-to-line, line-to-neutral, or line-to-ground arcing faults readily detected, especially with ground fault relaying | Ground detectors and fault locating equipment required for line-to-ground or line-to-neutral arcing faults. Line-to-line faults readily detected by phase over current devices unless fault current is severely limited | Ground detectors and fault locating equipment required for line-to-ground arcing faults. Transient overvoltages can cause additional insulation breakdowns. Line-to-line faults readily detected by phase over current devices unless fault current is severely limited. |

## Grounding Guidelines

The equipment grounding conductor, or the protective earthing conductor, in an electrical system provides a path for current to flow through during ground-fault conditions. The purpose of the grounding conductor is to:

- Provide a direct connection to ground
- Protect personnel from electrical injury
- Prevent possible damage to equipment
- Remove power by tripping the circuit breaker

You should apply the following safety rules to conform to electrical codes and provide a safe environment for the customer:

- If any electrical equipment is grounded, all other electrical equipment in the immediate area must be grounded or double-insulated. The immediate area is the space where a person can touch both the equipment and a grounded part.

- If you are working with grounded equipment or products, use only grounded or double-insulated tools and equipment.

## Grounding Connections

To function properly, the grounding (protective earthing) conductor must complete a solid electrical connection. Star washers that penetrate or bite into the surface provide a solid connection. Use them whenever possible. If you remove a star washer in a service procedure, always replace it when you reassemble the component. See Figure 2-2.

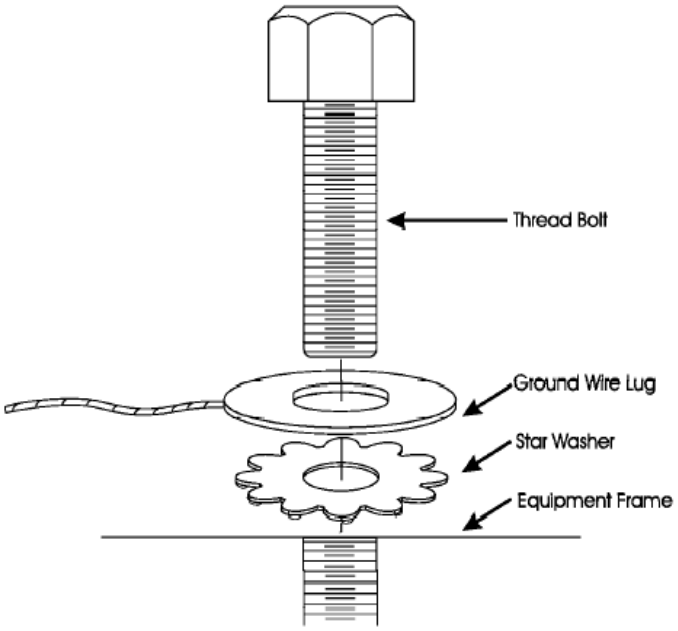



Figure 2-2. *Use of the Star Washer*

The ground pin on an ordinary extension cord or power tool cord is longer than the phase, or supply, and neutral prongs. When you plug in an extension cord or power tool, the ground pin is the first prong to connect and the last prong to open up when you unplug or disconnect.

Check all plugs, caps, and extension cords to make sure that the connections are solid and that the internal components are not distorted or bent because of prolonged use or damage. Replace the plugs, caps, and extension cords if necessary.

### Grounding Hazards

The equipment ground path must have a sufficiently low impedance to limit voltage rise and permit ample current flow so the over-current device operates quickly when a ground fault occurs.

Although volt-ohm meters have an ohms function, they cannot measure impedance. The ECOS model C7106, or an equivalent tester approved by IBM, measures impedance, and you must use it to verify the customer's ground connection. If this instrument is not 2-14 General Safety Course-2003 available in your country for your line voltage and plug configuration, consult your installation planning specialists for assistance.

If a ground fault occurs in a grounded neutral system and the over-current device does not operate or operates slowly, the result can be any combination of the following:

- Serious injury to personnel
- Fire
- Destruction of equipment

Never disconnect a grounding conductor (green wire or green wire with yellow stripe). The purpose of a grounding (protective earthing) conductor is to protect you, not the machine. If you disconnect a grounding (protective earthing) conductor, you might experience an electric shock and injury if you touch the machine or an adjacent grounded machine.

When you troubleshoot a fault condition, such as a tripped circuit breaker, blown fuse, or burning wire, use extreme caution in locating or isolating the cause. If you remove the safety ground from a component or chassis and the problem goes away, the potential difference between the floating component and the frame, or any other ground reference point, is probably at full line potential. The situation is extremely dangerous.

A shock hazard can exist even though a motor is operating normally. You should always perform safety checks before you touch the case of a motor.

### Motor Grounding

Some IBM products contain motors that are mounted on electrically insulating shock mounts or shock absorbing material to suppress noise and vibration. The wiring, instead of the mounting bolts, provides the grounding for these motors. Some examples are drive motors, fan motors, and blower motors. IBM products that are double-insulated and have two-prong plugs do not have motor grounding.

For more information, read “Motor Grounding” in the “Grounding” section of the *Electrical Safety* handbook.

### Summary

Protective grounding (earthing) provides a direct path to earth or some other conducting body that serves in place of earth. The main purposes of the grounding (earthing) conductor are to provide a direct connection to the ground and to protect personnel from electrical injury.

This lesson presented the definitions of grounding (earthing) terms, the properties of grounded, floating, and impedant neutrals for electrical distribution systems, and grounding (earthing) safety rules. It also provided information and safety instructions for motor grounding, which is a feature on some IBM products.

## Lesson 3. Receptacle Safety


This lesson presents the procedures for verifying that the customer's power receptacles are wired properly and provide the correct voltage.

### Objectives

After completing this lesson, you should be able to:

- Identify the sources that contain the directions for checking a customer's 120 V ac receptacles
- Identify the source that contains the directions for measuring 400 Hz power
- Identify the basic safety procedures for checking 208/240 V ac receptacles

## Voltage Measurements and Ground Checks

The customer must provide the proper receptacle for the equipment. Table 2-3 presents the correct procedures for measuring voltage and for performing ground checks.

Table 2-3. *Voltage and Ground Check Procedures*

| Voltage | Procedure |
|---|---|
| 120 V ac circuit receptacles | Follow directions on the IBM-approved impedance tester. |
| 208/240 V ac receptacles | ▪ Perform the procedure in the "Power Receptacle Safety Check" section of the *Electrical Safety* handbook.<br>▪ Use a 120 V ac receptacle that has been previously tested to check the ground in the 208/240 V ac receptacle.<br>▪ Do not use the machine convenience power receptacle or a customer's receptacle that is equipped with a ground fault circuit interrupt (GFCI) device or a residual current device (RCD). Refer to the *Electrical Safety* handbook before you touch any part of a metal-clad connector or receptacle.<br>▪ Do not remove the face plates and covers from the receptacles.<br>▪ Perform the safe-to-handle check in the *Electrical Safety* handbook before you touch any part of a metal-clad connector or receptacle.<br>▪ Make sure the receptacle is properly connected to ground before you measure voltage.<br>▪ Use the ECOS C7106, or an equivalent tester approved by IBM, to verify the presence of a safe ground connection.<br>▪ Perform the impedance test with the ECOS C7106, or an equivalent tester approved by IBM. Do not omit this test.<br>▪ Contact your manager if you believe the receptacle is not properly connected to ground. |
| 400 Hz power | Refer to the product or machine service manual. |

## Summary

This lesson presented the reference sources that contain the directions, procedures, and safety guidelines for measuring voltage and performing ground checks. You should refer to the label on the ECOS C7106, or an equivalent tester approved by IBM, when you test 120 V ac receptacles. (The "Power Receptacle Safety Check" section of the *Electrical Safety* handbook contains the procedures and safety guidelines for testing 208/240 volt receptacles.) The product service documentation contains the procedures and safety guidelines for measuring 400 Hz power.

# Lesson 4. Customer Electrical Power Distribution


This lesson discusses the customer's responsibility regarding electrical power distribution or wiring that provides power to equipment. It also presents electrical power distribution problems and the corrective actions for each problem.

## Objectives

After completing this lesson, you should be able to:

- Identify four power distribution hazards and the corrective action for each hazard
- Identify the responsibilities of an IBM service representative regarding a customer's power distribution system

## Areas of Responsibility

Customer electrical power distribution is the electrical wiring that supplies power to the installed equipment. The customer's responsibility is to supply the correct electrical power source to the equipment and to comply with local and national codes.

As a service representative, your responsibility is limited to the area immediately surrounding the equipment you service. This area is represented as Area A in Figure 2-3.

The customer provides the receptacle. Do not proceed into the customer's primary power system beyond the face plate of the receptacle. In the case of permanently connected equipment, do not proceed beyond the point of fixed connection with the customer's power distribution system.

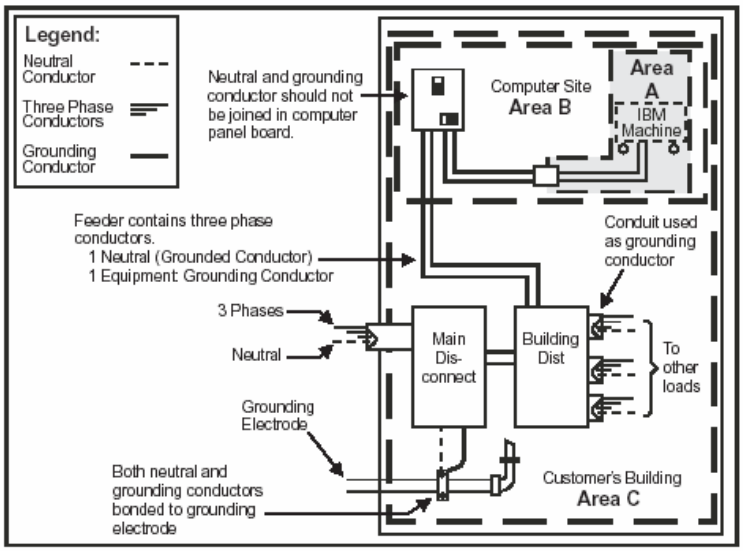



Figure 2-3. *A Typical Power System Environment*

The customer's facility might contain equipment and fixtures that influence your area of responsibility. Notify the customer and alert the responsible field manager if you suspect power and safety problems.

IBM strongly opposes exposing its employees to unsafe conditions. Report violations of national or local electrical codes to the customer. You should also notify the appropriate IBM sales and service manager if the problem is not resolved at the local level.

When you must remove power to service a machine, follow the procedures in the “Lockout-Tagout” section of the *Electrical Safety* handbook.

### Electrical Power Hazards

Table 2-4 presents problems you could encounter at a customer's facility and the corrective action or procedure for each problem.

Table 2-4. *Customer Ground Problems*

| Problem | Corrective Action |
|---|---|
| Green or green-with-yellow-stripe ground wire not connected | Do not touch the machine or any adjacent grounded machine. If an electrical fault occurs, the metal parts of the machine could be at line voltage potential. You could experience an electric shock and injury if you touch the machine or any adjacent ground machine. |
| National and local electrical wiring code violations | ▪ Perform appropriate safety procedures.<br>▪ Notify the customer about the violation. |
| Chassis removed from the machine | ▪ Do not perform power-on maintenance until you are certain that the continuity of the chassis safety ground to the machine frame remains intact.<br>▪ Refer to the maintenance documentation for specific instructions. |
| Power plug hardwired into the power distribution panel | Do not perform power-off servicing. Machines designed with a power plug should have a positive disconnect. |

## Summary

Customer electrical power distribution is the electrical wiring that supplies power to equipment. Some of the safety hazards you might encounter at a customer site include a disconnected green or green-with-yellow-stripe safety ground wire, a national or local electrical code violation, a chassis that has been removed from a machine, or a power plug that has been removed and hardwired into the power distribution panel.

You should not work in an unsafe electrical environment. When you encounter a hazard, perform the correct safety procedure and notify the customer and the responsible field manager.

# Lesson 5. Uninterruptible Power Supply


This lesson describes the electrical hazards of uninterruptible power supply (UPS) and standby power supply (SPS) units and the safety precautions for each hazard.

## Objectives

After completing this lesson, you should be able to:

- Identify the most serious UPS and SPS safety hazard
- Identify UPS and SPS safety procedures

## Uninterruptible Power Supply

An uninterruptible power supply and a standby power supply are devices that provide electrical power to equipment when the normal electrical power supply is interrupted. Some examples of a power interruption are:

- Total power outages that last a few seconds, several minutes, or several hours
- Low voltage conditions that last only a few milliseconds

Equipment that has an installed UPS continues to receive electrical power during a power interruption. The standby power supply can perform the same basic UPS functions.

Uninterruptible power supply and standby power supply units are available in single- and three-phase input and output and many different voltage ranges. They are available in a variety of technologies and sizes. Uninterruptible power supply and standby power supply units can use direct current (dc), batteries that convert power to alternating current (ac), or combustion engines that run generators to produce ac. Depending on the technology and the energy capacity, UPS and SPS units might be found on a desktop providing power to a personal computer or in dedicated equipment rooms that supply entire data centers. Uninterruptible power supply units do not usually present safety hazards to the operator or bystanders, but if you do not understand UPS operation, you can experience an electric shock that could cause a serious injury. Uninterruptible power supply units are capable of supplying lethal levels of electrical energy.

Uninterruptible power supply units do not usually present safety hazards to the operator or bystanders, but if you do not understand UPS operation, you can experience an electric shock that could cause a serious injury. Uninterruptible power supply units are capable of supplying lethal levels of electrical energy.

### Electrical Safety Exposure

Uninterruptible power supply and standby power supply grounding, wiring, and distribution systems must comply with country-specific electric codes. The most serious safety hazard with a UPS is the presence of output ac power when:

- There is no input power
- The power source is removed or unplugged

The surest method of de-energizing most electrical equipment is to disconnect the power cord. When a UPS or SPS is on the equipment, disconnecting the power cord only switches the unit into emergency mode power, and the batteries begin to supply power at the unit's output. Most UPS and SPS units have an alarm that activates when the unit is in emergency mode and the batteries are supplying the output power.

Most UPS and SPS units do have an on or off switch to disconnect the unit’s output. You should switch the UPS or SPS unit off so the unit cannot supply power to the attached equipment. You should also check:

- The front display panel to verify that the batteries are not supplying power
- The output power circuit to verify that electrical energy is not present

You must perform the procedures for controlling hazardous energy before you perform maintenance or service on equipment that has a UPS or SPS. If the UPS or SPS output circuit has a disconnect that locks, you must use the standard lock and tag to lock and tag the output circuit. If the output circuit does not have a disconnect that locks, you can use a tag on the output circuit that isolates the output power.

You must also implement an additional method for opening the circuit, such as removing fuses, removing circuit elements, or disconnecting the power supply conductors at the UPS or SPS or connected equipment. You should not create any additional safety exposures when you isolate the output power.

### Chemical Safety Exposures

You must recognize and protect yourself from the chemical and other energy hazards of a UPS or SPS. There are hazards associated with the corrosive chemicals and gels that are used as battery electrolytes. You must use the appropriate protective equipment for the service operation. The protective equipment includes safety goggles, chemical protective gloves, and aprons. You must also be able to flush your eyes and skin immediately with lots of fresh water if you make contact with any corrosive chemicals. You must have adequate ventilation for installing UPS or SPS units with batteries that generate combustible gases as they vent. A minimum of two air changes per hour is recommended. This requirement is primarily for large lead-acid battery banks.

### Other Safety Exposures

Another potential exposure associated with UPS and SPS systems is hazardous energy released when metallic tools inadvertently short across the battery terminals. The energy released can be so intense that the arc can cause a serious burn injury. Protective shields should be installed over the battery terminals so you cannot drop hand tools across the battery terminals. If protective shields have not been provided, approved temporary insulating covers, blankets or shielding should be used to protect the exposed terminals. You should also use the appropriate personal protective equipment to protect your face and body from burns due to arc or blast.

## Summary

An uninterruptible power supply (UPS) and a standby power supply (SPS) are devices that provide electrical power to equipment when the normal electrical power supply is interrupted. This lesson described the following electrical hazards of UPS and SPS units:

- Exposure to corrosive chemicals
- Inadequate ventilation
- Metallic tools that short across battery terminals
- Presence of output ac power with no input power

This lesson also identified the following safety precautions for each hazard:

- Install protective shields over battery terminals.
- Wear safety goggles, protective gloves, and aprons.
- Implement a tag that isolates output power and another method to open the circuit.
- Implement a minimum of two air changes per hour.

# Lesson 6. Lockout-Tagout


This lesson is about safe work practices and your responsibilities to yourself and others.

## Objectives

After completing this lesson, you should be able to:

- Identify the lockout-tagout procedure on hardwired machines
- Identify the lockout-tagout procedure on machines connected through a line cord and plug to an ac power source

## Electrical Safe Work Practices

As a service representative, your work requires that you respond effectively to a number of important electrical safety considerations. You might encounter electrical hazards as a result of:

- Unsafe service procedures
- Electrical clearance
- Maintenance clearance
- Improper grounding
- Customer power supply problems

**Note:** Electrical and mechanical clearances required for servicing and maintaining equipment should be provided with the machine documentation.

Follow each manufacturer's clearance guideline to prevent injury from electric shock or other related hazards.

Follow good safety practices to ensure your safety and the safety of others. Observe the following guidelines when you work in areas where potential electrical hazards exist:

- Use appropriate personal protective equipment for the exposed parts of your body
- Wear nonconductive head protection whenever there is a danger of head injury from electric shock or burns.
- Wear protective equipment for your eyes and face whenever there is danger of injury from an electric arc, or flash, or an electrical explosion.
- Ask another person to stay nearby when you work on or near exposed energized electrical parts or circuits (above 42.4V peak (30V RMS) AC, or 50V DC) which could result in involuntary muscle activation or cardiac fibrillation due to accidental contact.
- Do not use metal ladders when you work on or near electrical circuits.
- Do not wear exposed rings, bracelets, wristwatches, chains, or other jewelry while operating or servicing machines or equipment with exposed moving parts or while working on live electrical circuits.
- Do not wear metal-rimmed glasses when contact with live electrical circuits is possible.
- Use insulated tools or handling equipment if the tools or equipment might make contact with exposed energized conductors or circuit parts.
- Use fuse handling equipment to remove or install fuses when the fuse terminals are energized.
- Use nonconductive ropes and handlines near exposed energized parts.
- Use protective shields and barriers or insulating materials to protect you from shock, burns, or other electricity-related injuries when you work near exposed energized parts.
- Comply with safety signs and barricades that warn about electrical hazards.

You must use extreme caution when you work on equipment that was installed by the customer and not by a service representative. A receptacle could be improperly wired, a grounding conductor and a phase could be reversed, or the shell of a receptacle could be at line potential. You should work on energized

equipment *only* when it is necessary to perform diagnostics, calibrations, or troubleshooting.

Discuss with your manager any concerns or questions you have about working in electrical environments. For additional information about safe work practices, refer to Module 5 in this workbook.

Read the "Lockout-Tagout" section in the *Electrical Safety* handbook to learn more about the procedures to follow when you service equipment.

## Hardwired Equipment

Table 2-5 presents the lockout-tagout procedure for the following equipment:

- Equipment that is hardwired to the power source
- Equipment that has a plug and cord connection, but the plug is not accessible

Table 2-5. *Lockout Procedure for Hardwired Equipment*

| Step | Procedure |
|---|---|
| 1 | Explain the lockout-tagout procedure that IBM requires. |
| 2 | Review the customer's procedures and resolve any conflicts. |
| 3 | Locate and identify all the customer circuit breakers, disconnect switches, or other energy isolation devices that will be locked and tagged. Two or more energy sources could be involved in the lockout-tagout procedure. |
| 4 | Notify all personnel near the equipment you are servicing that you are performing the following tasks:<br>▪ Turning off the power to the equipment and securing the equipment under lockout-tagout<br>▪ Working on the equipment in areas that will be extremely dangerous if power is restored |
| 5 | Explain to all personnel that they must not restore power during lockout-tagout for any reason. |
| 6 | Perform the power-off procedure for the equipment. |
| 7 | Ask the customer to turn off the energy isolation device that supplies power to the equipment. |
| 8 | Place your safety lockout padlock on the energy isolation device so the energy isolation device cannot operate. * |
| 9 | Fill in the blanks on a Danger-Do Not Operate Tag form. Secure the tag to the shackle of your padlock. ** |
| 10 | Make sure no one is at risk. |
| 11 | Verify that the power is disconnected. Operate the controls to power up the equipment. If the equipment operates, you have not located all the energy sources, or you have identified the wrong energy isolation device. As you perform this test, do not overlook any other intermediate controlling devices you might have turned off, such as the equipment's service disconnect or unit emergency power off (UEPO) switch. |
| 12 | Return the operating controls to the off position. |
| 13 | Before you touch any electrical circuitry, use your volt meter to verify that no voltages are present. |
| 14 | Perform all necessary power-off service tasks. |
| 15 | Restore power to the machine in the correct order after you complete the power-off service tasks. Before restoring power, perform the following checks:<br>▪ Check in and around the equipment to make sure no one is at risk.<br>▪ Check for tools left in the equipment.<br>▪ Check that all ground wires have been reconnected correctly.<br>▪ Check for safety guards that are out of place.<br>▪ Notify personnel that the lockout-tagout condition is ending. |
| 16 | Remove each padlock and tag. All owners must remove their padlock and tag. |
| 17 | Ask the customer to return the energy isolation device to the on position and resume normal service operations. |

***** If multiple service representatives are working on the hazardous portions of the equipment, each service representative must apply a padlock. Use a multilock hasp to apply multiple locks. The procedure has two steps:

1. Clamp the multilock hasp on the energy isolation device so the energy isolation cannot operate.
2. Place each padlock on the multilock hasp so no one can remove the hasp.

There is also a specific procedure for an electric cabinet (panel) door. Do not lock the door of any electric cabinet (panel) box that includes non-related circuit breakers. However, depending on the local code and code enforcement authority, the doors of these electrical panels can be locked:

- A free-standing power distribution unit (PDU) equipped with a door you can lock and an emergency power off (EPO) switch that can interrupt all power leaving the PDU and that is accessible with the door closed and locked
- An electrical panel that contains only circuits that can be interrupted by the room EPO

****** If you need more space to insert the padlock shackle through the tag grommet, use a cable tie to secure the tag to the padlock. Occupational Safety and Health Acts require you to fasten the tag, with your name written on it, to the padlock so there is no doubt or confusion about the padlock owner.

## Plugged Equipment

Table 2-6 presents the lockout-tagout procedure for equipment that uses a line cord and plug to connect to ac power.

Table 2-6. *Lockout-Tagout Procedure for Line Cord and Plugged Equipment*

| Procedural Step | Procedure |
|---|---|
| 1 | Notify all personnel near the equipment you are servicing that you are performing the following tasks:<br>▪ Turning off the power to the equipment and securing the equipment under lockout-tagout<br>▪ Working on the equipment in areas that will be extremely dangerous if power is restored ***** |
| 2 | Explain to all personnel that they must not restore power during lockout-tagout for any reason. |
| 3 | Examine the plug. If the equipment power plug has a metal shell, or if the plug is connected to a metal-shell in-line connector, do not touch the plug until you successfully complete the safe-to-handle check. |
| 4 | Turn off the power to the equipment. |
| 5 | Unplug the equipment ac power cord from the customer's power receptacle or connector. |
| 6 | Examine the plug for these conditions:<br>▪ If the plug has blades with a hole in one or more blades, then you should:<br>1. Secure a safety lockout wire, a Danger-Do Not Operate tag, and a safety lockout padlock to the plug.<br>2. Write your name and all other important information on the tag.<br>▪ If the plug cannot accommodate the safety lockout wire, you should perform the following tasks to secure the plug:<br>1. Place the plug inside a safety lockout bag.<br>2. Pull the drawstring tight, slide the clamp up against the bag, and fold down the locking lever.<br>3. Secure a safety lockout padlock to a Danger-Do Not Operate tag and tie the drawstring so the clamp cannot release.<br>4. Write your name and all other important information on the bag. |
| 7 | Before you touch any electrical circuitry, use your volt meter to verify that no voltage |

| | |
|---|---|
| | Potential is present. |
| 8 | Perform all power-off service tasks. |
| 9 | Restore power to the equipment after you complete all the power off service tasks.<br>Before restoring power, perform the following checks:<br>▪ Check in and around the equipment to make sure no one is at risk.<br>▪ Check for tools left in the equipment.<br>▪ Check for disconnected wires.<br>▪ Check for safety guards out of place. |
| 10 | Notify all personnel that the lockout-tagout condition is ending. |

* - Use the lockout-tagout procedure for hardwired machines if the cord plug is not accessible.

## Ensuring Safe Plugs

You must measure the electrical contacts of the plug to ensure that voltage has not been applied to the machine from another source, such as from another IBM machine or a multivendor service (MVS) machine that is either directly or channel attached.

If you are checking a metal-clad plug or connector, do not touch the plug shell until you perform the following safe-to-handle check in the *Electrical Safety* handbook:

1. Measure voltages from the phase pins to the ground pin and neutral (if present). All values should be less than 1.0 V ac.

2. Measure the resistance between the ground pin and the machine's frame for approximately zero ohms. This measurement normally shows some resistance; the amount depends on the size and length of the ground conductor.

Read about the safe-to-handle check in the "Miscellaneous Safety Tips" section of the *Electrical Safety* handbook.

## Measurement Procedures

Never make any assumptions about the presence or level of electrical power. The presence of more than one power source in computer equipment can complicate the process of removing electrical power from a machine. To ensure that no unsuspected hazardous voltage is present in a supposedly non-energized machine, you must identify and remove all sources of energy before proceeding with any maintenance activity.

Before beginning any repair or maintenance activities, use the appropriate meter to complete all necessary measurement procedures correctly. Refer to the operating instructions to be sure that the device you are using can measure the type of power.

**Note:** It is extremely important to test your meter to make sure it is working properly before you touch a component. Follow the meter checkout procedure in the "Tools" section of the *Electrical Safety* handbook to ensure that the readings you obtain are accurate.

## Summary

This lesson presented the lockout-tagout procedures for hardwired and plugged equipment. It also

presented the safety requirements for energized equipment, multiple representatives, and personal tools and ornaments, such as jewelry and watches.

You must use extreme caution when you work on equipment that was installed by the customer and not by a service representative. The wiring could be improper, a grounding conductor and a phase could be reversed, or the shell of the receptacle could be at line potential. You should perform only diagnostics, calibrations, or troubleshooting tests when you work on energized equipment.

# Module 3. Product Safety Review


This module discusses product safety awareness. The components of product safety are:

- Prediction, which uses engineering judgment and expertise to predict potential product defects, failure modes, misapplications, and misuses
- Prevention, which implements preventive techniques to minimize potential hazards throughout the design, manufacturing, marketing, and service processes
- Action, which identifies and corrects issues promptly.

The lessons in this module are:

Lesson 1. Product Safety Standards
Lesson 2. Reporting Product Safety Incidents

# Lesson 1. Product Safety Standards


Concerns about product safety continue after the product passes the design, manufacturing, and installation phases. This lesson discusses the product safety standards and the product safety rules for service representatives.

## Objectives

After completing this lesson, you should be able to identify the responsibilities of service representatives regarding product safety.

## IBM Is Committed to Safety

IBM is obligated to deliver safe products and services. Meeting these obligations also reduces the risk associated with product liability for IBM. The product obligations include the following:

- Complying with industry safety standards and government regulations
- Maintaining engineering ethics and practices
- Designing fail-safe product devices
- Addressing cradle-to-grave product life-cycle issues

IBM strives to minimize potential health and safety hazards to all persons who are directly or casually exposed to its products. The Product Safety Engineering Departments (PSED) perform the following functions during the design phase for a new product:

- Identify the specific safety design criteria
- Identify the potential hazards in a product design
- Recommend actions or design changes to eliminate or control potential hazards
- Resolve potential hazard concerns with the program team
- Verify the operation of safety design features
- Document the safety of the final product design
- Monitor the field performance of the safety features throughout the product's life cycle

Before IBM releases a hardware, field maintenance, or chemical supply product, a qualified IBM product safety engineer or chemical coordinator reviews a product as part of the Product Safety Review Board (PSRB). A PSRB is applicable to the following products:

- All hardware that IBM or an IBM business venture sells, rents, leases, installs, or services
- Products with an IBM type number
- Supplies for products with an IBM type number
- Hardware that does not bear the IBM logo
- Product subassemblies
- Product parts
- Major new product feature releases
- Field maintenance tools
- Field maintenance chemical products
- Safety engineering changes

The Product Safety Review Board (PSRB) assesses each product for compliance with IBM internal safety standards, external agency safety standards, government regulations, and international safety standards. The PSRB reviews all aspects of the product's life cycle, which include the following:

- Environmental considerations in the product design and implementation
- Recycle and disposal features and requirements

The product manager, who is responsible for introducing the product to market, initiates the PSRB and verifies that all PSRB documentation is complete before IBM releases, installs, services, or uses the product.

## Potential Safety Hazards

Although IBM makes every effort to eliminate hazards, there is always the possibility for a hazardous situation when IBM service representatives install and service IBM and non-IBM products. Some potential safety hazards include the following conditions:

- Unprotected hazardous voltages
- Unprotected mechanical hazards
- Accessible laser beams (potentially hazardous laser radiation)
- Exposure to ionizing (e.g., X-rays) or nonionizing radiation (e.g., IR, UV, microwave, magnetic field)
- Fire or high temperatures that originate from a product
- Chemical products or supplies that are not used as intended

## Product Safety Labels

Product safety labels are used to identify hazards on machines and chemical products. There are two groups of product safety labels:

1. Machine safety label, which is information affixed to a machine to identify personal hazards.
2. Chemical product label, which contains information that identifies hazardous substances. This label is affixed to products issued for sale and field use. Label content and design may vary in different countries.

A safety alert symbol on a machine indicates a potential safety hazard. It is composed of an equilateral triangle surrounding an exclamation mark.

A signal word is a distinctive word on a label that alerts the viewer to the existence and level of a hazard. Signal words are limited to DANGER and CAUTION on IBM products. DANGER, CAUTION, and WARNING are used as signal words on non-IBM products.

- DANGER indicates the presence of a hazard with the potential to cause death or serious personal injury.

- CAUTION indicates the presence of a hazard with the potential to cause moderate or minor personal injury.

On IBM and non-IBM products, DANGER on a label has white letters on a red background. The safety alert symbol is a white triangle with a red exclamation mark.

On IBM and non-IBM products, CAUTION on a label has black letters on a yellow background. The safety alert symbol is a black triangle with a yellow exclamation mark.

On non-IBM products, WARNING on a label has black letters on an orange background. The safety alert symbol is a black triangle with an orange exclamation mark.

## Safety Rules for Service Representatives

All service representatives must read and understand the original manufacturer's service and installation instructions before installing or servicing an IBM or non-IBM product that requires working near or within an electrical hazard area. The *IBM General Safety Course 2003* is not a substitute for this requirement. IBM has specific safety rules regarding certification marks, installation, line cords, chemicals, and non-IBM products.

### Certification Marks

Safety approvals are generally required on electrical devices that are powered from ac sources or high energy dc sources (above 42.4V peak (30V RMS) AC, or 50V DC)

Safety approval on such products is a legal requirement in many countries, as well as an IBM international requirement.

Each agency has its own unique mark. For a product to be approved for use by one of these agencies, it must be tested and properly marked.

These certification marks are usually found beside the power inlet or power cord.

All products must comply with the certification and safety standards of the countries in which the products are marketed, installed, serviced, and used.

Refer to Appendix A for the product certification marks from recognized certification test labs and hazardous chemical labels for various countries.

### Installation
Do not install, service, or use a product that does not have a valid certification plate with the appropriate certification marks for the geographical location (the country) of installation. Notify your product safety authority and your manager immediately about the missing certification plate. If the situation involves a chemical product, your manager must contact your business unit's chemical coordinator for guidance.

### Line Cords
You must use line cords that are approved by IBM. Do not use line cords that have been altered in any way. Do not repair line cords because the replacement or repair of a line cord and end plug *voids* the product's certification approval. You must order line cord sets through the IBM distribution center.

### Chemicals
Chemicals must be used as originally intended. New uses must be approved by a chemical coordinator who is a member of the PSRB team. Use only chemicals approved by IBM.

You cannot purchase chemicals from petty cash or accept vendor-free sample programs without prior written permission from your business unit chemical coordinator. The chemical safety rules guarantee a review of each chemical so service representatives do not use a chemical that is unsafe, does not meet country regulations, or is incompatible with the hardware.

### Non-IBM Products
All non-IBM products must be certified by a recognized certification test lab as meeting all the safety standards and compliance requirements. This includes all non-IBM products that are included in an IBM Maintenance Agreement. The testing laboratory's certification mark communicates the following:

- The product is safe to use for its intended purpose.
- The product complies with required national safety standards.
- A product safety inspection guide is available in the RETAIN database by searching on keywords such as SAFETY, MPM, or OEM. The TDR record is H137785.

## Product Toxicology
The IBM Center for Process and Product Toxicology hotline is available 24 hours a day to provide information to help you respond to:

- Concerns about regular use and toxicity of any product, or catastrophic failure and toxicity of any product
- Customer requests for emissions data
- Customer concerns about product failures
- Customer requests for battery Material Safety Data Sheets (MSDS)
- Regulatory and standards pressures

The IBM Center for Process and Product Toxicology is located in the United States. The center's toll-free telephone number for North America is 1-800-745-2200. In countries outside North America, call 1-303-939-2200.

## Summary
This lesson discussed IBM's product safety obligations and product safety rules for service representatives. Before IBM releases a new product, the Product Safety Review Board (PSRB) reviews all aspects of product design and implementation and verifies product compliance with internal and external agency safety standards and government regulations. IBM has also established safety rules for

service representatives regarding product installation, line cords, chemicals, and non-IBM products. Service representatives must read and understand the original manufacturer's service and installation instructions before working on equipment that requires work near or within an electrical hazard area.

# Lesson 2. Reporting Product Safety Incidents


This lesson explains how to report a product safety incident and what facts to include in an incident report narrative. All product safety incidents should be reported immediately and must be reported within 24 hours. For information about reporting safety incidents that do *not* involve products, refer to the "Reporting Safety Incidents" lesson in Module 6 of this workbook.

## Objectives

After completing this lesson, you should be able to:

- Define a product safety incident
- Identify the contents of a product safety incident report

## Reporting Potential Hazards

A potential hazard is any product that appears unsafe to you or the customer. You should notify your manager and the Product Safety Engineering Department (PSED) or the product safety authority about potential hazards that are caused by a design or manufacturing flaw. You should contact the Product Safety Engineering Department or product safety authority at the plant of control within 24 hours.

You can locate the Product Safety Engineering Department at the plant of control by accessing the IBM Blue Pages at:

http://w3.ibm.com/bluepages

**Note:** If viewing this file via Adobe Acrobat Reader and if connected to the network, you may click the link to access this information now.

Select **Job Responsibility** from the drop-down menu in the "Search on" field.

Type Product Safety in the "Search for" field.

Select or type **ALL** in the "Select Directory" field.

Click **Submit** to obtain a list of individuals with product safety responsibility.

## Product Safety Incidents

IBM defines a product safety incident as an event with any of the following conditions:

- The event occurred during distribution, installation, implementation, service, or disposal of an IBM product or a product that IBM supplies.

- The event resulted in death, personal injury, or negative health impact.
- The event resulted in adverse health effects from exposure to chemicals or radiation.
- The event resulted in serious product damage or damage to other property.
- The event involved possible escape of internal flames outside the product enclosure.
- The event involved fire or smoke in the product or malfunction of the product.

You should also report any concerns that a customer expresses about an incident or safety issue. IBM investigates any customer concern as a safety incident.

## Product Incident Reports

Product incident reports must include the following information:

- Product type, model, serial number, and manufacturer
- Date and time of the incident
- Customer name and address where the incident occurred
- Current location of the product
- Names and job titles of people who were injured or involved in the incident
- Condition of the injured people
- Medical treatment, hospitalization, notification, and other follow-up actions
- Narrative of the incident
- Name, address, outside telephone number, tie line number, and e-mail address of the local IBM manager

Product safety incident reports are classified as IBM Confidential. You should also use the term *alleged* in all product incident reports. You should not draw any conclusions or suggest what might have happened to cause the *alleged* incident.

Refer to the Corporate Product Safety Web site, http://w3-1.ibm.com/chq/environment/ps/index.htm, which provides access to an on-line form for reporting a Product Safety incident and a list of product safety contacts.

## Assisting the Investigation

The product incident report must include a narrative that the Product Safety Engineering Department (PSED) at the plant of control and the local product safety authority use in their investigations. The narrative should include details about the room layout, equipment, and external conditions such as the weather, room temperature, and humidity. You must also report specific details when electric shock is involved in the incident.

Table 3-1 presents the details you should include in the narrative. You should discuss the incident with the Product Safety Engineering Department (PSED) or product safety authority before you dismiss any detail as unimportant and not applicable to the incident.

Table 3-1. *Incident Report*

| | |
|---|---|
| **Narrative Item** | **Details** |
| Sketch of room layout, or pictures or video | The sketch, pictures, or video should include the location of:<br>▪ The product during the incident<br>▪ All equipment cabled to the product<br>▪ All equipment in the room plugged into the same electrical outlet or branch circuit<br>▪ The route and condition of power cords and cables attached to the product |
| Electric shock | If the incident involved electrical shock, the narrative should include: |

| | |
|---|---|
| | ▪ Room temperature and humidity.<br>▪ Results of an electric outlet safety check. Use an ECOS Model B7106, C7106 Accu-Test II, or ECOS Model 1023 Pow-R-Mate TM (or an IBM-approved equivalent).<br>▪ Results of a Wavetek Multimeter check that verifies that the grounding conductor in the power cord is 0.1 ohm or less.<br>▪ Details about any equipment that has a video display terminal. The narrative should include the answers to these questions:<br>▪ Was the video display terminal cleaned recently?<br>▪ Was the video display terminal sprayed with anti-static material? |
| Other equipment | The narrative should include details about:<br>▪ Other equipment operating in the immediate area, such as a headset, mouse, or microphone<br>▪ Other equipment the operator was using during the incident<br>▪ Other equipment connected to the allegedly unsafe product |
| Unusual events | The narrative should include any unusual events that occurred at the same time, such as:<br>▪ An electrical storm<br>▪ A power surge<br>▪ Repair work performed in the area<br>▪ A fire and the type of fire extinguisher |
| Personnel Involved | Service representative's name and telephone number |
| Alleged injury or damage | Type of injury or damage |

The Product Safety Engineering Department (PSED) or product safety authority might require a laboratory product analysis to identify the cause of the incident. The plant will notify the contact person named in the incident report and provide instructions for sending the product to the laboratory. If there was a repair action on the product, the repaired parts (or machine, if possible) must be held until disposition is determined by the Product Safety Engineering Department (PSED) or product safety authority.

## Communicating the Results of the Product Safety Investigation

The product safety organization at the plant of control issues a findings report at the end of the investigation. The local IBM manager receives the report and sends a copy of the report to the local or country product safety authority after the investigation of the alleged incident.

The manager of the local IBM office also meets with the customer and explains the outcome of the safety investigation. The plant advises the manager if IBM legal representatives should also attend the meeting.

## Summary

It is your responsibility to report product safety incidents or customer safety concerns to the product safety organization or authority and your manager within 24 hours. A product incident report must include details about the room layout, equipment, and external conditions such as the weather, room temperature, and humidity. The product safety organization or authority at the plant of control issues a findings report after an incident is investigated, and the local IBM manager meets with the customer to explain the outcome of the investigation.

# Module 4. Chemical and Physical Agent Safety


This module identifies the health effects of exposure to chemicals, asbestos, lasers, and excessive noise. It also discusses material safety data sheets, IBM requirements, preventive measures, first aid measures, and other information about preventing or minimizing the risk of exposure.

The lessons in this module are:

Lesson 1. Chemicals and Health Effects
Lesson 2. Right to Know
Lesson 3. Asbestos
Lesson 4. Laser Safety
Lesson 5. Hearing Protection

## Lesson 1. Chemicals and Health Effects


This lesson discusses the health effects of exposure to chemicals that you might encounter on the job. This lesson also discusses:

- What you should know about the chemicals you use on the job
- Basic principles of toxicology
- Chemical handling procedures

### Objectives

After completing this lesson, you should be able to:

- List and describe the chemical types that put you at risk
- Understand principles of toxicology like dose, synergism and additive effects
- Identify the IBM guidelines for handling and storing chemicals
- Identify the IBM position regarding the chemical exposure hazard of carbon black

### Introduction

Service personnel use chemicals during customer hardware maintenance activities. The chemicals you might use are lubricants, flammable cleaning solvents, adhesives, sealants, and paints. You should know how exposure to these chemicals can affect your health and the health of others. You should also know how to protect yourself from exposure to hazardous chemicals. The following actions can protect you from exposure to hazardous chemicals:

- **Know the hazards** of the chemicals you may be exposed to on the job, how the chemicals react, and how they can affect you.
- **Use necessary protection**, such as personal protective equipment (PPE).
- **Follow safe work practices** each time you handle a chemical.

## IBM Chemicals

Only IBM approved chemicals can be used by service and maintenance personnel.

Before IBM selects a chemical product, a team of qualified health, safety and chemical management professionals reviews the chemical toxicity and the intended use. IBM observes the following procedures to protect your health and to prevent the incompatibility of a chemical with the hardware:

- The IBM business unit's chemical coordinator, as a member of the Product Safety Review Board (PSRB), must approve all purchases of new chemicals before you place an order.
- You cannot purchase chemicals from petty cash without prior written approval from the business unit's chemical coordinator.
- Individual employees cannot receive free chemicals from vendors without prior written approval from the business unit's chemical coordinator. If you receive unsolicited chemicals from vendors or other sources, contact your business unit's chemical coordinator.

### Chemical Classifications

There are four types of chemicals that can put you at risk:

- Toxic agents, which are substances that can cause illness or death
- Corrosives, which can burn skin or eyes
- Reactives, which burn, explode, or give off toxic gases when they are dropped, heated, or mixed with certain other substances
- Flammables and combustibles, which are liquids and gases that catch fire easily, burn quickly, or explode

### Chemical Hazards

The hazards associated with a chemical depend on the following factors:

**Toxicity.** All chemicals can cause harm. When a small amount of a chemical causes damage, the chemical is considered toxic.
Conversely, when it takes a large amount of a chemical to cause damage, the chemical is considered relatively non-toxic.

**Routes of Exposure.** You can be exposed to chemical hazards in three ways. Chemicals can enter the body if they are:

- Absorbed through the skin or splashed into the eyes. Vapors from solvents can also be absorbed through the eyes.
- Inhaled in the form of dust, gas, or vapors.
- Ingested, especially if you eat or smoke around chemicals, or if you eat without washing your hands after you handle chemicals.

**Dose.** The beneficial or harmful effects of chemicals depend on the amount that reaches a susceptible site on or in the body. For example, when you take two aspirins, enough of the medication needs to make its way to your head to relieve the headache. In general, the greater the amount of a substance that enters your body, the greater the effect on your body. When you inhale a toxic chemical, the dose you receive depends on four factors:

- The concentration of chemical in the air
- The rate and depth of your breathing
- The amount of the chemical that stays in your lungs and is absorbed into your bloodstream
- How long the exposure lasts

The solvents that service representatives use in the field cause common physical effects. In low

concentrations, they can mildly irritate the eyes, nose, and throat of a sensitive individual. In higher concentrations, they can cause light-headedness and reduced coordination. Field measurements have not detected high concentrations at IBM customer environments or during lab testing of mock service situations. You should not normally encounter any of these effects if you use IBM-approved chemicals as intended.

**Duration of Exposure.** The longer you are exposed to a chemical, the more likely you are to be affected by it. Repeated exposure over time may also cause harm because some chemicals can accumulate in the body.

Body clearance mechanisms work at a certain rate and can be overcome if the rate of exposure exceeds the rate of removal. If this happens, the chemical might begin to accumulate in the body to a point where symptoms of overexposure occur. For example, the body can readily cleanse itself of small amounts of cleaning fluid solvents absorbed into the body during the course of normal recommended usage. The body might not cleanse itself as completely when the exposure level is increased, such as when excessive amounts of cleaning fluid are used in a confined area. In this case, the total amount of solvent uptake through both inhalation and skin absorption can overload body clearance mechanisms. The total body concentrations can then reach a point where adverse physical effects result. These effects can include blurred vision and reduced coordination. The effects are readily reversible when the source of exposure is removed. When this occurs, the clearance mechanisms eventually catch up to the task of removing the chemicals that originally caused these disturbances.

On the other hand, other chemicals are stored in the body for long periods. For instance, lead is stored in the bone, and polychlorinated biphenyls (PCBs) are stored in the fat. Some substances that are deposited in the body, such as asbestos fibers, remain in the body forever.

**Reaction and Interaction of Chemicals.** You might be exposed to more than one chemical on the job. You should be aware of possible reactions and interactions between chemicals. A reaction occurs when chemicals combine with each other to produce a new substance. The new substance might have properties different from those of the original substances, and it could be more hazardous. For example, if household bleach and lye (such as a drain cleaner) are mixed together, a highly dangerous chlorine gas and hydrochloric acid can form. The MSDS for a chemical often lists its potential hazardous reactions and the substances you should not mix with the chemical.

An interaction occurs when exposure to more than one substance results in a health effect that is different from the effects of either one alone. One kind of interaction is called synergism, a process of two or more chemicals producing an effect that is greater than the sum of their individual effects. For example, by either smoking one pack of cigarettes per day, or being heavily exposed to asbestos, you can develop the risk of lung cancer six times higher than the risk of someone who does neither. But, if you smoke a pack a day *and* are heavily exposed to asbestos, your risk can be 90 times higher than the risk of someone who does neither. In this example of synergism, 1 + 1 = 90.

Another interaction is potentiation, which occurs when an effect of one substance is increased by exposure to a substance that would not cause that effect by itself. For example, although acetone does not damage the liver by itself, it can increase carbon tetrachloride's ability to damage the liver. In this example of potentiation, 1 > 1.

The additive effect is another type of chemical interaction. When two or more chemicals have the *same* health effects, their effects are additive (1 + 1 = 2). For example, if you work with isopropanol during a work shift and consume alcohol in the evening, and if your body does not have enough time to eliminate the isopropanol absorbed in your body, the combined effects are additive or have a doubling effect. This does not apply to chemicals that have synergistic or potentiating effects.

Few chemicals have been tested to determine whether interactions with other chemicals occur.

**Sensitivity.** People have different levels of sensitivity to the effects of a chemical. Some of the factors that determine how an individual reacts to a chemical are:

- Age
- Sex
- Inherited traits
- Diet
- Pregnancy
- State of health
- Medication, drugs, or alcohol use

Depending on these factors, some people experience the toxic effects of a chemical at a lower (or higher) dose than others.

People can also become allergic to a chemical and have a response that is different from the response of people who are not allergic. This response frequently occurs at a very low dose. All chemicals do not cause allergic reactions. Substances that cause allergies are called allergens or sensitizers. Epoxies and latex are examples of sensitizers.

For more information about sensitizers and protection from sensitizers, refer to the “Personal Protective Equipment” lesson in Module 5 of this workbook.

### Chemical Handling, Storage, and Disposal

Use the following general guidelines when you handle chemicals:

- Carry in passenger vehicles only the quantity necessary for daily hardware maintenance. Ensure compliance with your country's hazardous material transportation regulations.
- Use only approved containers for transporting or storing chemicals.
- Ensure that chemicals are labeled properly. If labels are missing or illegible, contact your business unit's chemical coordinator or your country's parts distribution center to obtain replacement labels.
- Store chemicals in approved, ventilated areas. Chemicals should be kept away from heat, moisture, sunlight, and incompatible chemicals (refer to the MSDS for a list of incompatibles).
- Chemicals regulated for transportation must not be carried onboard airplanes. Contact your local chemical coordinator for guidance.
- Flammable chemicals (whose flash point is less than 37.8°C or 100°F) should be stored in approved flammable storage cabinets.
- Approved flammable storage cabinets or approved flammable liquid storage rooms may be required by local fire codes or insurance company regulations. Contact your local IBM GOHS representative or chemical coordinator for guidance.
- Store chemicals in locked cabinets when not in use.
- Close containers immediately after use.
- Do not block ventilation ducts or pipes with chemical containers.
- Dispose of chemicals safely, according to approved procedures. Refer to the chemical's MSDS or consult your local chemical coordinator. Do not pour chemicals down drains.
- Remote service representatives are not to carry or ship chemicals regulated for transportation on board an airplane. Consult your local chemical coordinator for guidance.

### First Aid for Chemical Exposure

Refer to the “First Aid” section of the MSDS for information. To ensure immediate response, you should be familiar with the information on the MSDS for the products you use before working with a chemical.

## Aerosol Container Safety

Service personnel must ensure that they follow proper safety practices when using, transporting, or storing aerosol containers. When aerosol containers are not handled properly, they can rupture with a violent force that might result in injury and property damage. The general requirements for aerosol containers are:

- Obtain customer approval before using aerosol containers at a customer's location.
- Products in aerosol cans must be used in well ventilated areas
- Do not expose aerosol containers to direct sunlight or a heat source above 48°C (120°F).
- Aerosols (ex: spray paints) can be extremely flammable and must not be used near ignition sources.
- Spray paint cans must be transported with the MSDS.
- Do not store aerosol containers in motor vehicles.
- Do not transport or store excess quantities of aerosol containers.
- Chemicals such as flammable aerosols that are regulated by the Department of Transportation (DOT) and International Air Transport Association (IATA) must not be carried on air carriers. Only trained personnel are allowed to ship these materials via air carriers. Please contact your chemical coordinator if you have any questions

## Lead Safety

Lead is a very common and poisonous material. You would normally need to inhale (breathe) or ingest (eat) significant amounts of lead - or materials contaminated with lead - before you would ever develop symptoms of poisoning. But if you handle printed circuit cards  perform hand soldering with lead-based solders, or handle electronic cables, wires and cords insulated with polyvinyl chloride (PVC) insulation your hands can come in contact with small amounts of lead dust or particles.

If you should drink, eat foodstuffs or smoke before washing your hands, there is a risk of accidental ingestion of lead. The key to prevention is your awareness of the risk and your attention to personal hygiene. Always wash your hands thoroughly with soap and running water after handling printed circuit cards or lead-based solders, or PVC insulated cords and cables, especially before eating, drinking or smoking. Keep food and drinks out of work areas where these materials are used.

## IBM Toners and Carbon Black

Carbon black, which is used as a pigment in paints, plastics, inks, toners, and other products, has been reclassified by the International Agency for Research on Cancer as possibly causing cancer in humans.

Based on the scientific information available today, IBM does not believe toners and inks containing carbon black pose a health hazard in settings where airborne concentrations are below recommended occupational exposure levels. Skin contact with carbon black does not represent a health hazard.

The reclassification resulted from a study in which laboratory rats developed lung tumors after being exposed to high concentrations of carbon black in the air. Studies conducted with other animals have not found any association between carbon black and lung tumors. Studies of workers in the carbon black manufacturing industry have found no association between carbon black and cancer.

The frequently asked questions in the following table address concerns about toners and carbon black.

Table 4-1 (Page 1 of 2). *Frequently Asked Questions about Toners and Carbon Black*

| | |
|---|---|
| **Question:** | Does use of copying machines or printers pose a cancer risk? How about sitting near such machines over an extended period of time? |
| **Answer:** | There is no scientific evidence connecting use of such equipment to cancer. Proximity to |

| | |
|---|---|
| | such machines does not pose a health risk. |
| **Question:** | I do maintenance and repairs on printers and photocopiers. Should I be concerned that such work could result in cancer? |
| **Answer:** | No. Toners and inks containing carbon black do not pose a health hazard in occupational settings where airborne concentrations are below recommended occupational exposure levels. |
| **Question:** | How does IBM know that levels of carbon black in IBM and customer locations are below recommended occupational exposure levels? |
| **Answer:** | Representative samplings of IBM and customer locations during normal maintenance activities have shown that levels are well below occupational exposure limits. |

| | |
|---|---|
| **Question:** | I get toner on my hands when I change the toner in the copying machine. Will this result in cancer? |
| **Answer:** | There is no scientific evidence that touching products containing carbon black results in cancer. |
| **Question:** | If IBM doesn't believe carbon black leads to cancer, why is it changing the warnings shipped with IBM products? |
| **Answer:** | IBM is changing Material Safety Data Sheets (MSDSs) in conformance with certain countries' government regulations. |
| **Question:** | Will IBM conduct an independent study on the health effects of carbon black? |
| **Answer:** | IBM does not believe that an independent study is needed. IBM's health and safety professionals closely monitor the scientific, clinical, regulatory, and environmental information available for each chemical that IBM uses and will continue to track developments related to carbon black. |
| **Question:** | Is IBM saying that the International Agency for Research on Cancer made a mistake when it reclassified carbon black? |
| **Answer:** | Human studies of disease performed to date do not show an association between carbon black exposure and cancer. The reevaluation of carbon black as a possible human carcinogen was based upon limited animal data and should not be considered a statement of potential risk to humans. |
| **Question:** | Should I change any of my working procedures because of the reclassification? |
| **Answer:** | No. |

## Summary

IBM chemicals used for hardware maintenance are reviewed for safety and approved by IBM

professionals. The toxicity, dose, body sensitivity, route of exposure, duration of exposure, and the chemical reaction and interaction influence the harmful effects of a chemical. The body has mechanisms to cleanse itself of chemicals. These mechanisms can be overwhelmed if chemical exposures are high over a prolonged period of time.

This lesson also discussed carbon black, a pigment in paints, inks, plastics, toners, and other products. The International Agency for Research on Cancer has reclassified carbon black as possibly causing cancer in humans. Based on the scientific information available today, IBM does not believe that toners and inks containing carbon black pose a health hazard in settings where airborne concentrations are below recommended occupational exposure levels.

# Lesson 2. Right-to-Know


This lesson discusses right-to-know legislation, also called hazard communication or Workplace Hazardous Materials Information System. This lesson also discusses:

- Sources of information about chemical hazards
- What a Material Safety Data Sheet (MSDS) is
- How to read MSDS
- Important information provided on MSDS

## Objectives

After completing this lesson, you should be able to:

- Identify the key elements of right-to-know legislation
- Identify the IBM guidelines for handling and storing chemicals
- Identify the product information on a Material Safety Data Sheet (MSDS)
- Find an MSDS for an IBM Field Use Material

## Right-to-Know

Right-to-know (R-T-K) refers to legislation that addresses the right of employees, customers, and various community organizations to request and receive information about toxic substances that are present in the workplace. Right-to-know legislation exists in many countries. The name and requirements of the regulation vary from country to country. Usually, the regulation requires companies to develop and document a hazard communication program.

Some common elements of a hazard communication program are:

- Employee education
  Employers must train employees to safely handle chemicals that are present in the workplace. Employers must educate employees about the possible effects of overexposure to chemicals they work with or are in close proximity to in the workplace.

- Availability of information
  Employees must have toxicity information about the chemicals readily accessible at the workplace. IBM customers also have a right to this information. Refer to the Material Safety Data Sheet (MSDS) topics in this lesson to learn more about the MSDS components.
- Container labeling

Specific information that must appear on the containers of hazardous materials. The required information includes product identifiers, manufacturer information and hazard warnings. The label content, design, and language can differ from country to country.

You have a *right-to-know* about the hazards of the chemicals that you use on the job, and you also have the right to know about potentially hazardous materials in customer environments. Your customers also have these rights. If a customer requests information about a chemical we use in their workplace, provide a copy of the product's MSDS.

### Where to Find Chemical Hazard Information

You can determine the hazards of a chemical by reading:

- The container label
- The MSDS
- Posted signs and warning in the workplace

**Labels**: Container labels give the following information:

- **Name or trade name** of the chemical.
- **Physical hazards**, such as flammable, explosive or corrosive.
- **Degree of risk**. Look for signal words such as DANGER, WARNING, or CAUTION. DANGER indicates the most severe hazard and CAUTION indicates the least degree of risk.
- **Health hazards,** like irritation, poison.
- **Precautions to take** during and after working with chemicals.
- **How to handle, store, and possibly dispose of chemicals**.
- **First aid**.

Never remove, deface or obscure container labels. Contact your local chemical coordinator for assistance if you cannot find or read a label.

When chemicals are transferred from a large container to a smaller, more convenient container, label the secondary container with the identity of the chemical and any appropriate hazard warning statements.

**MSDS**: The product's MSDS provides the best source of information about chemicals that you might use or with which you might come in contact. An MSDS is a technical document that provides detailed and comprehensive information about a chemical and its hazards.

Read the MSDS before you handle a chemical. If you are unable to obtain an MSDS, contact your manager or local chemical coordinator. More information about MSDS and the information that they provide is presented later in this section.

**Posted signs and warnings**: Look for signs and warning at the customer location. Signs may be posted to warn of chemical baths, tanks of other hazardous areas.

Chemical safety information is also available from the following sources:

- *General Safety* handbook
- Safety Memorandums (SMs) or Safety Advisories
- Engineering Change (EC) announcements
- IBM RETAIN tips (RETAIN is the Remote Technical Assistance Information Network)
- Your business unit's chemical coordinator or IBM Corporate Chemical Management

## Obtaining Material Safety Data Sheets

To obtain an IBM MSDS, go to the IBM CimCam Application, an intranet site at the following address, where the instructions reside:

http://w3-1.ibm.com/chq/chemical/

If you are looking for information on IBM service chemicals or product supplies, select "Search for IBM Service Chemicals or Product Supplies" on the left hand navigator panel. When working at a customer location you may be exposed to chemicals. These chemicals may be from the customer's normal business processes or temporary activities like renovation or construction. If you have concerns about chemicals used in a customer location ask your customer contact for copies of the MSDS for the chemicals used in your work area. If you have any questions about the MSDS or need help in evaluating your exposure ask your manager or Global Occupational Health Services.

**Material Safety Data Sheets**

Various MSDS formats are used, but a complete MSDS includes the following categories of information.

**Product Information.** Product information includes product identifiers, manufacturer's name, address, and emergency telephone number. This information is important when comparing a chemical label to an MSDS to see that the MSDS matches the chemical and if it is necessary to contact the manufacturer.

**Hazardous Ingredients.** The hazardous ingredients section lists the individual hazardous chemicals in the product and their relative percentage of concentration. If exposure limits are established, they may appear beside each ingredient. Exposure limits are guidelines that establish an exposure that should not be exceeded when averaged over an eight-hour workday. TLVs, LC50s, and LD50s are exposure guidelines and information that may also appear beside each ingredient or can be established for the product as a whole. This information helps establish the degree of hazard to humans.

**Note:** Appendix D explains TLVs, LC50s, and LD50s. This information is important if your job involves long exposures or high concentrations of these hazardous ingredients. Wearing protective clothing or taking other protective measures as described on the MSDS is vital to your health.

**Physical Data.** Physical data includes a variety of parameters, such as physical state, odor, boiling point, solubility in water, specific gravity, and evaporation rate, that physically characterize a product.

This information helps you predict how the material will act and react so you can select the appropriate safety equipment. Before you handle a material, you should know certain things about the material, such as how it behaves at different temperatures or when it is exposed to water. For example, if a material has a low boiling point, high vapor pressure, fast evaporation rate, and a high percentage of volatility, it is probably an inhalation hazard, and special ventilation or respiratory protection might be necessary. The higher the temperature, the more active the material. If the material is also flammable or toxic, even stronger precautions are necessary.

**Fire and Explosion Hazard.** Fire and explosion hazard information lists the substance characteristics that determine the flammability of the material and the type of extinguishing materials that will best fight an accidental fire. This information is very important for fighting fires involving a chemical product.

**Reactivity Data.** Reactivity data is information about the chemical stability of the product and chemicals that react dangerously with the product. This information enables you to store and handle a material more safely when you know how it might react to changes in temperature or to contact with other materials.

**Toxicological Properties.** Toxicological properties describe how the product is likely to enter the body and how the body reacts to long-term (chronic) and short-term (acute) exposures. This information is important for your safety and the safety of others.

**First Aid Measures.** First aid measures state the specific first aid measures for overexposure to a product.

**Preventive Measures.** Preventive measures list the personal protective equipment, handling procedures, and engineering controls you use during product shipping, storage, use, disposal, and emergency circumstances. This information helps safeguard your health and the health of others.

**Preparation Information.** Preparation information identifies the personnel responsible for preparing the MSDS and its preparation date.

You can view a sample MSDS in Figure 4-1.

Figure 4-1 *Sample Material Safety Data Sheet (MSDS)*

| **SECTION 1 – CHEMICAL PRODUCT AND COMPANY IDENTIFICATION** | |
|---|---|
| Product Identifier | (WHMIS Classification) |
| Product Use | |
| Manufacturer & Supplier Contact Information | |

| **SECTION 2 – COMPOSITION / INFORMATION ON INGREDIENTS** | | | | |
|---|---|---|---|---|
| Hazardous Ingredients (specific) | % | CAS Number | $LD_{50}$ of Ingredient (specify species and route) | $LD_{50}$ of Ingredient (specify species) |
| | | | | |

| **SECTION 3 – HAZARDS IDENTIFICATION** |
|---|
| Route of Entry<br>☐ Skin Contact ☐ Skin Absorption ☐ Eye Contact ☐ Inhalation ☐ Ingestion |
| (Emergency Overview) (WHMIS Symbols) |

| **SECTION 4 – FIRST AID MEASURES** |
|---|
| Skin Contact, Eye Contact, Inhalation, Ingestion |

| **SECTION 5 – FIRE FIGHTING MEASURES** | | |
|---|---|---|
| Flammable<br>☐ Yes ☐ No | If yes, under which conditions ? | |
| Means of Extinction | | |
| Flashpoint ( °C) and Method | Upper Flammable Limit (% by volume) | Lower Flammable Limit (% by volume) |
| Auto ignition Temperature ( °C) | Explosion Data – Sensitivity to impact | Explosion Data – Sensitivity to Static Discharge |

| SECTION 6 – ACCIDENTAL RELEASE MEASURES |
|---|
| Leak and Spill Procedures |

| SECTION 7 – HANDLING AND STORAGE |
|---|
| Handling Procedures and Equipment, Storage Requirements |
| **SECTION 8 – EXPOSURE CONTROL / PERSONAL PROTECTION** |
| Exposure Limits<br>☐ ACGIH TLV ☐ OSHA PEL ☐ Other (specify) |
| Specific Engineering Controls (such as ventilation, enclosed process) |

| SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES |
|---|
| Storage Requirements |
| Handling Procedures and Equipment |

| SECTION 10 – STABILITY AND REACTIVITY | |
|---|---|
| Chemical Stability<br>☐ Yes ☐ No | If no, under which conditions ? |
| Incompatibility with Other Substances<br>☐ Yes ☐ No | If yes, which ones ? |

| SECTION 11 – TOXICOLOGICAL INFORMATION |
|---|
| Effects of Acute Exposure, Chronic Exposure |

| SECTION 12 – ECOLOGICAL INFORMATION |
|---|
| Aquatic Toxicity |

| SECTION 13 – DISPOSAL CONSIDERATIONS |
|---|
| Waste Disposal |

| SECTION 14 – TRANSPORT INFORMATION |
|---|
| Special Shipping Information |

| SECTION 15 – REGULATORY INFORMATION | |
|---|---|
| [WHMIS Classification] | [OSHA] |
| [SERA] | [TSCA] |
| ***This product has been classified in accordance with the hazard criteria of the Controlled Products Regulation (CPR) and the MSDS contains all of the information required by CPR*** | |

| SECTION 16 – OTHER INFORMATION |
|---|
| |

Knowing what data a chemical container label and an MSDS should include will help you find it more quickly. If you feel that an MSDS is not complete, or if you don't fully understand it, contact your manager, your business unit's chemical coordinator, or your local Occupational Health Services department before you work with the particular chemical. When you receive an MSDS for a material that is new to you, immediately read and understand the entire MSDS.

The MSDS is the basic tool to use as a guide to safe practices and emergency response. It is up to you to read and follow the instructions on the MSDS.

### Chemical Safety Concepts on a Material Safety Data Sheet (MSDS)

Your best defense against accidents and injury is understanding and interpreting the data in the MSDS and on product labels. You should understand the following MSDS concepts:

- Odor and appearance
  The differences between the odor and appearance listed on the MSDS and the odor and appearance of the actual chemical product can indicate that the stock has expired or that you have the wrong chemical. Do not use the chemical if there are differences in odor and appearance. Contact your business unit's chemical coordinator for guidance. Odor and appearance can usually be found under “Physical Data” on the MSDS.

- Specific gravity
  If the specific gravity of a chemical that is insoluble in water is less than 1, the chemical will float on water. As a result, water must not be used to fight a fire involving this material because the fire will spread. Solubility in water and specific gravity can usually be found under “Physical Data” on the MSDS.

- Volatility
  Volatility is the measure of a material's tendency to vaporize or evaporate at room temperature. Volatile substances become more volatile at higher temperatures, and such conditions should be avoided during use. These substances require adequate ventilation to minimize acute effects, such as headache and dizziness. Volatility can usually be found under “Physical Data” on the MSDS.

- Vapor density
  Chemicals with a vapor density greater than 1 are heavier than air and are likely to concentrate in low or enclosed places, such as under or along floors, possibly creating fire, explosion, or health hazards. Generally, all vapors and gases will eventually mix with air; however, mechanical ventilation at floor level might be needed if a large quantity of a nonflammable substance, with a vapor density greater than 1, is spilled. Vapor density can usually be found under “Physical Data” on the MSDS.

- Flash point
  The flash point is the lowest temperature at which a liquid gives off enough vapor to ignite in the presence of a source of ignition, such as an open flame or spark. The flash point is an indicator of a chemical's flammability. Liquid products with a flash point of less than 37.8°C (100°F) are flammable; chemicals with a flash point between 37.8°C (100°F) and 93.3°C (200°F) are combustible. You should keep these chemicals away from heat and sources of ignition and store them in approved flammable storage cabinets. You can find the flash point in the “Fire and Explosion Hazard” section of the MSDS.

- Acute and chronic exposures
  You can find acute and chronic effects of toxic substances in the toxicity section of the MSDS. Table 4-2 summarizes the differences between acute and chronic effects.

| Table 4-2. *Differences between Acute and Chronic Effects of Toxic Substances* | |
|---|---|
| **Acute** | **Chronic** |
| Occurs immediately or soon after exposure. | Occurs over time. |
| Often involves a high exposure (large dose) over a short period. | Often involves low exposures (small doses) over a long period. |
| Often reversible after exposure stops. | Many effects are not reversible. |
| Can be minor or severe. For example, a small amount of ammonia can cause throat or eye irritation; larger amounts can be serious or even fatal. | Chronic effects are still unknown for many chemicals. For example, most chemicals have not been tested for cancer or reproductive effects. |
| Relationship between chemical exposure and symptoms is generally, although not always, obvious. | It can be difficult to establish the relation between chemical exposure and illness because of the long time delay between the chemical exposure and the appearance of symptoms. |
| Knowledge of effects is often based on human exposure. | Knowledge of effects is often based on animal studies. |

**Note:** Refer to Appendix D of this workbook for more detailed information about toxicity.
Although you cannot readily alter the toxicity of a substance you are working with, you can control the degree of chemical hazard by:

- Minimizing your exposure to the chemical
- Understanding the hazards posed by the chemical
- Using chemicals for their intended purpose
- Ensuring adequate ventilation and, where necessary, using personal protective equipment
- Ensuring that all chemicals are assessed through the Product Safety Review Board (PSRB) process by a qualified chemical coordinator

## Summary

Right-to-know legislation is intended to protect employees by giving them access to information about the chemicals they use or may be exposed to on the job. Product labels, MSDS and posted warning signs are used to inform employees about chemical hazards.

The container label provides information about physical hazards, the degree of risk, health hazards, precautions, chemical handling, storage, and first aid measures. The MSDS provides more comprehensive hazard information that includes hazardous ingredients, physical data, fire and explosion information, reactivity data, toxicological properties, first aid measures, and other preventive measures.

This lesson explained key concepts, such as chemical odor and appearance, specific gravity, volatility, vapor density, and flash point, that help you understand the information on an MSDS. Knowing about a chemical will help you handle products safely and minimize your chemical exposure. Review the MSDS for chemical products you use and follow any precautions stated on the product label.

# Lesson 3. Asbestos


This lesson describes the health risks associated with asbestos, lists the products that may contain asbestos, and presents the safety requirements for working with asbestos. It also explains how to identify asbestos indicators and how to react when asbestos is present.

## Objectives

After completing this lesson, you should be able to:

- Identify the health risks from exposure to asbestos
- Identify the products that may contain asbestos
- Identify the safety precautions to take when you damage asbestos material

## Asbestos

Asbestos is a generic term for a number of hydrated mineral silicates that separate into flexible fibers when they are crushed. Asbestos has many characteristics that make it commercially valuable. For example, it does not burn easily, does not easily conduct heat or electricity, and remains unaffected by most chemicals. Each kind of asbestos has certain qualities, so each kind has different uses. Chrysotile is the best known, most abundant, and most widely used asbestos.

Commercial use of asbestos has declined since the late 1970's when the US Environmental Protection Agency banned certain uses of asbestos. Scientific evidence linked asbestos t certain health problems. Historically, manufacturers used the long fibers of chrysotile for such products as fireproof clothing and theater curtains. Shorter chrysotile fibers were used to make heat-resistant electrical insulation and brake linings for motor vehicles. The shortest chrysotile fibers were used in the production of caulking, cement pipe, floor tile, and plastics. Although the use of asbestos in buildings has stopped, the asbestos containing products installed in the past remain. Buildings constructed in the United States before 1981 might contain asbestos.

Several diseases are associated with asbestos exposure. These include asbestosis, lung cancer, mesothelioma and gastrointestinal cancer. However, the mere presence of asbestos does not mean there is a health risk. The risk of disease is from breathing airborne asbestos fibers. The asbestos containing material must be physically disturbed in some way for asbestos fibers to be released, become airborne, and pose an inhalation hazard. You must avoid disturbing asbestos material to prevent creating airborne fibers.

It is not always possible to determine the presence of asbestos by simple visual inspection. You should check a material even when you only suspect the presence of asbestos. The following products may contain asbestos:

- Boiler and chiller insulation
- Pipe and fitting insulation
- Spray-applied fireproofing
- Floor tiles, mastics, and adhesives
- Asbestos cement panels (example, Transite, Asbestolux)
- Pump packing
- Roofing materials

You can encounter asbestos materials in buildings above hung ceilings, in telephone closets, in switch rooms without hung ceilings, and as pipe insulation. The asbestos material used for pipe insulation can look like corrugated paper. Pipe insulation containing asbestos is often covered with a canvas or cloth wrapping.

You might also find asbestos material in some ceiling tiles and fire-resistant dry wall. It can also be in basements, equipment rooms, crawl spaces, and service tunnels. If you suspect that asbestos material is present at a customer site, notify your manager. If you accidentally damage asbestos materials when you are working, perform the following procedure:

1. Stop work activities and isolate the affected area.
2. Protect uncontaminated items from contamination.
3. Vacate the area.
4. Notify your manager

IBM allows only licensed, authorized asbestos-handling contractors to work with asbestos. The asbestos regulations require specialized training and licensing or certification for asbestos workers.

## Summary

Asbestos is the generic term for hydrated mineral silicates that separate into flexible fibers. Asbestos does not burn or conduct heat or electricity easily. Until the late 1970’s, manufacturers used asbestos in insulation, floor tiles, roofing materials, mastics, adhesives, and other building materials.

Scientific studies link asbestos to several diseases. Be aware of potential sources of asbestos exposure so you can avoid them. IBM allows only certified asbestos-handling contractors to work with asbestos. If you suspect the presence of asbestos at a work site, the correct procedure is to stop work, take steps to protect yourself and others, and notify your manager.

# Lesson 4. Laser Safety


This lesson discusses laser properties, laser classifications, optical fiber systems, and fiber optic cables. Looking directly into a laser beam can cause eye damage, and working with the chemicals that are used in fiber optic technology can cause eye and skin irritation. This lesson describes the laser safety precautions.

## Objective

After completing this lesson, you should be able to identify the safety precautions for working with lasers and fiber optic cables.

## Optical Fiber and Laser Safety

Under normal operating conditions, fiber optic technology in itself does not present any unique safety hazards. However, rapidly growing field use of products and networks that use various forms of fiber optic and laser technology can result in exposure to equipment that does not meet IBM's high safety standards.

## Lasers

A laser is a device that produces a high-intensity visible or invisible light beam. LASER is an acronym for Light Amplification by Stimulated Emission of Radiation. Laser light may be in the ultraviolet, visible, or infrared portion of the spectrum.

Laser light has three important properties:

- Monochromaticity. All light consists of waves through space. The length of the light wave determines the color of the light. Laser light consists of only one wavelength of light.
- Directionality. Common light sources, such as a light bulb, emit light in all directions. Lasers emit light that travels in a single direction and in a very concentrated beam.
- Coherence. Coherent light waves are of the same wavelength, are in step with one another or in phase with one another, and travel in the same direction. Only monochromatic and directional light is highly coherent.

Laser light is very bright or intense because it is a single color (or wavelength) and is concentrated in one direction. For example, an ordinary 100 watt bulb has 100,000 times as much power as a 1/1000 watt (1 milliwatt, or 1 mW) laser. But the 1 mW laser has a *brightness* ten million times greater than the light bulb. The brightness of the laser beam becomes a safety concern if a person looks directly into the beam.

## Laser Classification

Transmitters in optical fiber communication systems (OFCS) are either light-emitting diodes (LEDs) or lasers. The U.S. Food and Drug Administration (FDA) has developed a scheme to classify lasers based on their capability to produce injury. Similar classification schemes are used in other legal standards, such as the American National Standards Institute (ANSI) Z136.1 in the United States and the

International Electrotechnical Commission (IEC) 60825-1 in Europe. The FDA standard is used for the design of all IBM products that will be introduced into commerce in the United States, while the European norm (EN) 60825-1 is used for the design of all IBM products that will be introduced into commerce in Europe.

**Classes:** The five laser classifications and their characteristics are:

- **Class 1**
  - Is incapable of producing eye or skin damage.
  - Has a power limit that depends on wavelength and time. (He/Ne Continuous Wave visible < .4 milliwatts).
  - Requires warning in some countries only if housing a higher-class laser. Interlocks normally prevent access to a higher-class laser.
  - Is required by IEC 60825-1 to display an explanatory label with the words CLASS 1 LASER PRODUCT.

- **Class 2**
  - Is a low-power laser (Class 1 limit to less than or equal to 1 milliwatt).
  - Produces a visible laser beam
  - Laser light will be too dazzling to stare into for extended periods.
  - Can injure only if the human aversion response is overcome. The human aversion response is movement of the eyelid or head to avoid exposure to a noxious stimulant or bright light. This can occur within 0.25 seconds, which is blink reflex time.
  - Must display a Caution label on the laser.

- **Class 3a**
  - Power limits are 1 to 5 milliwatts.
  - Includes low-power lasers that may be sub-classified as “low-irradiance” or “high-irradiance” lasers.
  - Low-irradiance lasers require a Caution label or sign. These lasers do not normally cause injury if viewed for less than 0.25 seconds with the naked eye.
  - High-irradiance lasers require a Danger label or sign. These lasers are capable of producing injury if the beam is viewed for more than 0.25 seconds.
  - FDA in the United States restricts Class 3a to lasers with visible beams. International standards and the ANSI standard also include in Class 3a ultraviolet and infrared lasers with low-power invisible beams.

- **Class 3b**
  - Is a medium-power laser. The Class 3b power limits are 5 to 500 milliwatts for visible beams. In general for invisible beams, the Class 3b limits are greater than for Class 1 but less than 500 milliwatts for continuous-wave lasers.
  - Can cause injury from direct viewing or mirror-like (specular) reflections.
  - Requires a Danger area sign or label.
  - Requires engineering controls, such as beam stops, filters, attenuators, or interlocks.
  - Requires laser alignment procedures for maintenance personnel.
  - Requires eye protection for working with an open beam.
  - Requires an eye exam.

IBM uses Class 3b lasers, or semiconductor lasers, in optical fiber systems.

Semiconductor lasers, without added optics, have a large beam spread or divergence that produces large beam areas at relatively short distances away from the laser. The greatest danger with

semiconductor lasers is collecting all the power in the beam with magnifying lenses or collimating the beam at the source to maintain a small diameter over long distances.

- **Class 4**
  - Is a high-power laser greater than 500 milliwatts in the ultraviolet, visible, and infrared range
  - Can cause injury from direct, diffused, or specular reflections
  - Requires a Danger area sign or label
  - Requires a controlled room with interlocks, warning lights, or signs
  - Requires a key switch master lock
  - Requires eye protection
  - Requires an eye exam

### Optical fiber systems

Optical fiber communication systems are normally Class 1 systems and are incapable of producing potentially hazardous radiation during normal operation. However, if you remove a fiber optic cable connector during user maintenance or service and view the end of the operating fiber with an optical aid (such as a hand magnifier, loupe, or microscope), the concentrated radiant energy might damage your eye.

### Enterprise Systems Connection (ESCON)

The ESCON systems use a laser for optical data transfer. The laser is classified as a Class 1 device, which is incapable of producing damaging radiation levels. The laser is an indium gallium arsenide phosphide laser, which is able to produce Class 3b laser radiation. However, the power output of the unit is limited to comply with Class 1 requirements. The module is designed so there is no human access to laser radiation above a Class 1 level during normal operations, user maintenance, or prescribed service conditions.

### Inner Systems Channel (ISC)

The ISC uses a laser for optical data transfer. The laser system is classified as a Class 1 device. The laser diode is capable of producing Class 3b levels of radiation; however, the unit uses an open fiber interlock system. This system senses a disconnected or broken fiber cable and changes the state of the laser from a continuous mode to a pulse mode. When the laser is in pulse mode, the output power from the laser unit is reduced to a Class 1 level. When you perform diagnostics or service on the unit, follow all service instructions and never use optical magnifying devices to view the laser.

You might encounter high-powered laser equipment when you work with fiber optics. Safety warnings that alert you to potential hazards in the area should be posted.


Figure 4-2. *IEC-type Class 2 Laser Warning*

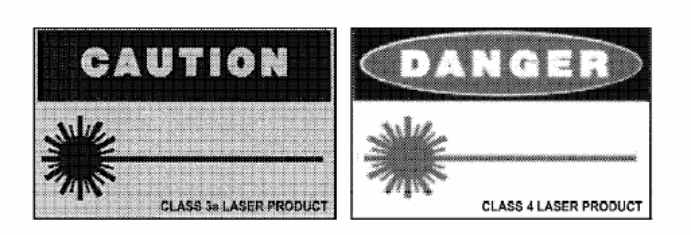



Figure 4-3. *FDA-type Class 3a Low Irradiance and Class 4 Laser Warning*

## Laser Service Groups

The ANSI Z136.2 standard recommends assigning lasers to service groups. The service group determines the accessible emission level of the laser when it operates at maximum power for its intended use. The service group labels should be located in plain view of the equipment and in the vicinity of the connectors, outlets, patch panels, and patch cords.

Service group labels SG1, SG2, and SG3a are used in an *uncontrolled* area. ANSI defines an uncontrolled area as an area where control for the purpose of radiation protection is not necessary.

SG1 - No labels needed

**SG2**
- CAUTION -
DISCONNECTED OPTICAL CONNECTORS
MAY EMIT OPTICAL RADIATION
DO NOT STARE INTO BEAM

**SG3a**
- CAUTION -
DISCONNECTED OPTICAL CONNECTORS
MAY EMIT OPTICAL RADIATION
DO NOT VIEW BEAM WITH
OPTICAL INSTRUMENTS

SG3b and SG4 labels are used in controlled areas where control for the purpose of radiation protection is necessary.

**SG3b**
- DANGER -
DISCONNECTED OPTICAL CONNECTORS
MAY EMIT OPTICAL ENERGY
AVOID DIRECT EXPOSURE
TO THE BEAM

**SG4**
- DANGER -
DISCONNECTED OPTICAL CONNECTORS
MAY EMIT OPTICAL ENERGY
AVOID DIRECT EYE AND SKIN EXPOSURE
TO THE BEAM

All OFCSs that use IBM equipment are classified SG1; however, wiring closets might contain equipment that is assigned to other service groups.

The control measures include:

- Handling procedures
- Product SG qualification
- Safety training
- Viewing distances
- Labels

## Laser Safety Measures

You should always observe the following laser safety measures:

- Never look directly into a laser source or a fiber optic connected to a laser source, either with the naked eye or through an unfiltered optical viewing device (like an eyepiece or magnifier).
- Some lasers and many OFCS devices operate in the invisible light spectrum and *do not* trigger the eye's blink reflex. Be careful with these systems as it may not be apparent that they are on, and they can be just as dangerous as high power visible laser systems.
- Use test equipment with the correct filtered optical viewing aid for the laser wavelength being tested.
- Never point a laser source toward another person and ensure that laser sources are not reflected off walls or machines toward another person.
- Never put a mirror in the laser path. The recommended method for verifying continuity is to use the appropriate optical test set. You should use only an indirect image converter or a similar device to view the end of a fiber that you suspect is energized.
- Additional Control Measures for OFCS Systems:

1. Work on OFCS systems should be done with the power off, if possible (follow lockout/tagout procedures).
2. If the power cannot be turned off, wear the appropriate laser protective eyewear and follow all precautions in the service manual.
3. If you do not know the Service Group Classification of your laser, assume it is SG3b.
4. Define a controlled area around a SG3b system.
5. Use safety connectors on laser outputs in uncontrolled areas.
6. Label the patch panel, patch cords and the outlet.
7. Use labeling in accordance with the ANSI Z136.2 standard.

It is also your responsibility to do the following:

– Observe all rules, procedures, and practices.
– Notify management immediately of conditions or practices that have the potential to cause personal injury or property damage.
– Report to management immediately any known or suspected exposure to optical radiation.

## Fiber Optic Cables

Fiber optic cables present very low potential for injury; however, there are some precautions:

- Glass fibers

  Cleaved glass fibers are very sharp and practically invisible. Splinters are very difficult to see and remove. You should wear safety glasses and collect broken or cleaved pieces on a piece of tape for disposal.

- Strength member fibers

  Hands and fingers can be lacerated if they become entangled in the fibers. Wear gloves for protection.

- Armor

  Wear gloves for protection from very sharp edges.

## Chemical Exposure

The following chemicals may be used with fiber optic technology. Take precautions to avoid the hazards from exposure to these chemicals.

- Isopropyl Alcohol
  - Is flammable
  - Can cause eye or skin irritation if it comes in contact with eyes or skin
  - Can result in narcosis and unconsciousness if inhaled for a prolonged period

- Interstitial Filling
  - Is the material in loose tube cables
  - Can cause irritation if it comes in contact with eyes or skin
  - Is combustible but not easily ignited

Fiber optic technology has limited hazards; however, you should practice these safety precautions:

- Be careful with cables and fibers.
- Wear safety glasses and gloves.
- Review the MSDS for all chemicals and safety procedures.

## Summary

A laser produces a high-intensity and sometimes invisible light beam. The properties of laser light can make even a low-power laser beam brighter than the sun. If you are directly exposed to a laser beam, you can experience skin injury and permanent eye damage.

Lasers have five classifications that range from Class 1 to Class 4. Class 1 is incapable of producing eye or skin injury. The potential hazard to eyes and skin increases with higher classes. For optical fiber communication systems, the service group, which is a second classification system, is used to express the potential hazard of the optical energy contained within the fiber. The potential hazard of the service group increases from SG1 up to SG4.

Some chemicals that are used in fiber optic technology present safety hazards. You should always wear safety glasses and gloves when you work with optical fiber systems and fiber optic cables.

# Lesson 5. Hearing Protection


This lesson describes how chronic noise exposure can cause hearing loss. It also presents noise exposure guidelines and the IBM noise exposure regulations.

## Objectives

After completing this lesson, you should be able to identify the IBM noise exposure guideline.

## Hearing Safety

The exposure of IBM service personnel to occupational noise is usually below the levels that can result in hearing impairment. However, you might encounter excessive noise levels when you visit a noisy customer account or participate in noisy recreational activities.

## Parts of the Ear

The human ear is an incredibly sophisticated and delicate instrument. It detects sound pressure signals that range from the faintest whisper to signals with a billion times more energy. It discerns, within an enormous range, the slightest differences in volume, pitch, and tone.

Sound travels as air vibrations or sound waves that strike the outer ear, which funnels them down the ear canal to the eardrum. The eardrum transmits these vibrations through three tiny bones to the cochlea, which is the organ that changes vibrations into nerve impulses that the brain can interpret.

The cochlea is most susceptible to damage from excessive exposure to noise. The cochlea is a coiled, liquid-filled tube that has thousands of tiny hair cells projecting from its walls. Vibrations from the tiny bones, which are called the hammer, the anvil, and the stirrup, are transmitted into the cochlea. The hair cells flex in response.

The hair cells at the beginning of the cochlea pick up high-frequency sounds, and the hair cells at the opposite end detect low-pitched, low-frequency sounds. The hair cells respond to countless combinations of pitch and intensity, so you experience an enormous variety of sound impressions.

## Noise-Induced Hearing Loss

The cochlea is susceptible to damage from excessive exposure to noise. Noise-induced hearing loss occurs when excessive noise exposures cause the hair cells to flex to such a degree that they are unable to return to their original position. The hair cells can no longer send nerve impulses to the brain, which results in hearing loss.

Chronic noise exposure affects only certain sections of the cochlea at first. The early damage usually affects that part of the cochlea that detects sounds outside the frequencies associated with everyday

speech. A person usually does not notice any damage because the ability to hear and understand ordinary conversation is unaffected.

In the later stages of high noise exposure, the sections of the cochlea that pick up speech frequencies are also damaged. As a result, a person cannot hear certain common syllables. The person hears distinct words in conversations as a confused mumble. Many individuals remain unaware of the problem because hearing loss is so gradual. They might ask people to repeat what they said, to speak louder, or to stop mumbling. They do not realize that the problem lies, not with the speaker, but with their own damaged hearing.

Hearing damage that results from occupational exposure is usually a painless process that takes many years to develop. The hearing damage affects the inner ear and is usually irreversible. Louder exposures shorten the length of time necessary to produce damage. Some short intense noise, such as a gunshot blast, can damage the ear drum and hearing instantly.

## Measuring Noise Levels

Noise levels are measured in decibels, or dBAs. Exposure levels can range from 0 dBA, which is the faintest sound a human can hear, to 140 dBA, which is the threshold of pain, and higher. Because of the enormous range of sound pressures that the human ear can detect, a logarithmic scale is used to describe increases in sound intensity. A 10 dBA increase indicates a tenfold increase in sound intensity; however, the average person perceives it to be only twice as loud. A chain saw (100 dBA) has 10 million times the sound intensity of a whisper (30 dBA).

Refer to Table 4-3 for a list of the decibel ratings of some common noise sources.

Table 4-3. *Noise Level Table*

| dBA | Source |
|---|---|
| 0 | Threshold of human hearing |
| 30 | Soft whisper |
| 40 | Suburban area at night |
| 60 | Normal male voice at 1 m |
| 61 | IBM 3800 printer, cover closed |
| 70 | IBM Series III copier |
| 78 | IBM 3800 printer, cover open |
| 90 | Lawn mower |
| 100 | Chain saw |
| 110 | Loud music |
| 115 | Portable stereo headset (high setting) |
| 140 | Gunshot |
| 180 | Rocket pad during launch |

United States occupational safety and health regulations allow exposure to industrial workers of no more than an average of 90 dBA of continuous noise (as opposed to impact noise, such as a gunshot blast) over an eight-hour work shift. The exposure time must be cut in half with each 5 dBA increase. No continuous noise over 115 dBA is permitted. Limits might be slightly different in other countries.

IBM has adopted a more conservative 85 dBA threshold for an eight-hour exposure and the same 5 dBA halving. An IBM employee's exposure is controlled to 90 dBA for four hours, 95 dBA for two hours, and 100 dBA for one hour. IBM uses a mathematical formula to sum up the total noise exposure from different noise levels that employees encounter in the course of a day.

Where employees are exposed to high noise levels, their exposure should be reduced:

- using engineering methods to reduce noise at its source
- limiting the duration of exposure through administrative means
- using personal protective equipment, such as earplugs or muffs

Notify your manager if you have concerns about noise exposure at work.

## Summary

Hearing loss occurs when chronic noise exposure damages the cochlea, which is the organ that changes sound vibrations into nerve impulses that the brain can interpret.

Noise levels are measured in decibels (dBA). The faintest sound a human can hear is 0 dBA, and the threshold for pain is 140 dBA. The IBM noise exposure regulation is 85 dBA for an eight-hour work shift. The allowable exposure time is cut in half with every 5 dBA increase.

Tell your manager if you have concerns about your exposure to noise. It may be necessary to measure noise levels in the workplace, to provide additional training or hearing examinations or use personal protective equipment.

# Module 5. Safe Work Practices


Safe work practices establish and maintain the safety culture of an organization. This module discusses how to work safely so you avoid situations that might put you and others at risk. It also explains how to minimize your exposure to personal injury by following safe work procedures and wearing personal protective equipment.

The lessons in this module are:

Lesson 1. Working Safely
Lesson 2. Personal Protective Equipment
Lesson 3. Cable Installation and Maintenance
Lesson 4. Motor Vehicle Driving Safety

## Lesson 1. Working Safely


This lesson discusses general safety guidelines for working at a customer's facility. It also presents the procedures for responding to a work environment that might expose you to safety and health risks.

### Objectives

.
After completing this lesson, you should be able to:

- Identify the guidelines for establishing a safe working environment
- Identify the procedure to follow when you recognize a potential safety exposure at a customer site

### Working in Unsafe Environments

A safe and healthy work environment is the most important safety factor. Do not work in customer environments that expose you to safety and health risks.

If you arrive at a customer site and recognize a potential exposure that can cause injury or illness, follow these steps:

| Step | Action |
|---|---|
| 1 | Advise the customer of the potential exposure and of your need to contact your field manager. |
| 2 | Disengage service delivery in a professional manner. |
| 3 | Notify the field manager of the potential exposure. |

The field manager conducts an assessment, contacts the health and safety manager, and verifies that the site is non-serviceable. A site is non-serviceable when:

- Your safety and health are jeopardized
- The safety and health of others are jeopardized
- Any property is damaged

The field manager discusses the issue with the customer contact and explains the reasons for not delivering service. The field manager and the customer contact agree on an action plan and communicate the plan to you. After the customer implements the action plan, the field manager conducts another assessment to verify that the site is serviceable. After the field manager designates the site safe and serviceable, you can provide service. The field manager also communicates with the health and safety manager, who alerts other managers about potential exposures at the site.

## General Safety Procedures

It is your responsibility to establish and maintain safety in your daily working environment. You must develop a safety sense so you can install and maintain IBM and other equipment manufacturers' (OEM) products without endangering your safety or the safety and property of others.

Table 5-1 states the safety guidelines for the following conditions:

- General safety
- Jewelry, clothing, and electronic equipment
- Working alone

Table 5-1. *Safety Guidelines*

| Environment | Safety Procedures |
|---|---|
| General safety | ▪ Take no action that makes a product unsafe or exposes customer personnel to hazards.<br>▪ Store removed machine covers in a safe, out-of-the-way place.<br>▪ Place your service case away from walk areas so no one can trip over it.<br>▪ Maintain safe conditions in the machine area during machine maintenance activity. |
| Jewelry, clothing, and electronic equipment | ▪ Remove watches, rings, necklaces, bracelets, chains, or other jewelry when you perform these tasks:<br>◆ Service a machine with exposed moving parts<br>◆ Work on live electrical circuits<br>◆ Work with chemicals<br>▪ Secure long hair, ties, scarves, and other loose clothing.<br>▪ Button shirt sleeves or roll sleeves above the elbows.<br>▪ Remove metal-rimmed glasses if contact with live electrical circuits is possible.<br>▪ Remove gloves, bandages, and finger cots so they won't be caught or snagged by moving machine parts when you service equipment. *****<br>▪ Remove headset radios, compact discs, and tape players when you work in these areas:<br>◆ Areas designated as hazardous<br>◆ Areas where power vehicles operate<br>◆ Areas that require hearing protection. |
| Working alone | ▪ Do not work alone in hazardous conditions. ******<br>▪ Do not work alone when you are near equipment that could expose you to hazardous voltages or hazardous levels of electrical energy.<br>▪ Notify your manager when the customer asks you to work alone under hazardous conditions.<br>▪ Ask another employee who is trained to respond appropriately to the specific task hazards to stay within sight and sound.<br>– Use a personal alert safety system so an alarm can be activated if you become incapacitated. Arrange for someone to respond immediately to the alarm. |

* Finger cots are permissible for disc wheel operations such as buffing or polishing.

** The following tasks are examples of hazardous activities that present the potential for injury:

- Servicing a closed system that contains acutely hazardous materials
- Working near chemicals that can cause eye injuries, inhalation contact hazards, or absorption hazards
- Working with high-pressure chemicals or chemicals with the potential for high energy release

### Verifying the Safety of an Electrical Environment

When you install or reconfigure equipment, or take equipment out of service, the first task is performing the safety tests for an electrical environment. Use a meter to perform these tests and verify the following:

- AC power outlets are correctly wired and safety grounds are present.
- Shock hazards do not exist between any accessible metal parts, such as safety ground, metal shells on connectors, or exposed frames.

When you perform maintenance tasks that require connections to existing cables, you must also check for shock hazards on the existing cables.

You should stop working if you discover incorrect wiring or other shock hazards. Report the problem to your manager and to the customer's management. Do not perform any work in the area until the problem is corrected and the hazards are eliminated.

### Working with Power On

Under normal circumstances, IBM does not allow you to service equipment with the power on. Servicing equipment with power on is permitted *only* when any of the following conditions exist:

- Product maintenance procedures state that service representatives can perform the task with power on.
- Power off introduces or increases safety hazards.
- Specific tests require power on.

When you perform tasks with power on, do not touch or make contact with any moving parts, circuit elements, or electrical terminals that carry hazardous voltages or hazardous energy.

### Servicing Non-IBM Products

When you service non-IBM products, you must remember that IBM has no control over the product design, construction, or quality.

Follow these basic rules when you service non-IBM products:

1. **Service only the specific products that are included in an IBM Maintenance Agreement.**
   Do not service products that are similar to, or appear to be the same as, products that are included in an IBM Maintenance Agreement. You might be unfamiliar with the engineering change (EC) level of the non-IBM product, and the non-IBM product might also present hazards that are unacceptable to IBM. The non-IBM product might be ineligible for an IBM Maintenance agreement.

2. **Do not repair any service-exchange-only product.**
   A network environment has signal cables to connect IBM and non-IBM products. The cables and the attached products also create an expanded electrical environment that presents safety risks. Hazards that originate from one product or its power source can present a safety risk while you work on another product.

You must connect and disconnect cables safely to prevent an electrical shock. For example, faulty building wiring can place ac line voltage on a machine frame within a network and on the shelf of its signal cable. When you connect or disconnect cables, stand on a non-conducting surface. This position minimizes the risk of your becoming the conductive path between possible electrical current and ground for that current.

Faulty building wiring can also cause hazards from one of a pair of connectors after you separate the connectors. You can experience an electric shock even though you measure no previous voltage to electrical ground. When you separate connectors, do not grasp two different metal parts simultaneously. You must perform the safety procedures for separating metal shell connectors.

The proper disconnect sequence is:

| Step | Action |
|---|---|
| 1 | Disconnect the power cord at the outlet. |
| 2 | Disconnect the signal cables at the outlet. |
| 3 | Disconnect all cables at the product. |

Perform the procedure for metal-clad plugs and connectors in the *Electrical Safety* handbook to avoid the risk of electric shock when you disconnect coaxial or twinaxial cables.

The proper connect sequence is:

| Step | Action |
|---|---|
| 1 | Connect all cables at the product. |
| 2 | Connect the signal cables at the outlet. |
| 3 | Connect the power cord at the outlet. |
| 4 | Turn on the product switch. |

A recognized testing laboratory certifies the safety of all products that are included in an IBM Maintenance Agreement. All IBM products, including line cords and plugs, comply with product certification standards recognized in the country where the products are marketed in (Refer to Appendix A for product certification examples). Replacing a plug instead of the entire line cord assembly might void the approval of the product.

The following IBM product features are often not included in non-IBM products:

- Double-pole power switches (both sides of primary power are switched on or off).
- Ring voltage covers in modems. The ring voltages can be as high as 250 volts.

**Protecting Yourself**
Shorting between adjacent poles of high-current supplies or high-capacitance circuits can cause arcing or ejection of molten metal, which might cause burns. Even low-voltage circuits can be dangerous. Protect yourself with shielding or remove power. Wear safety glasses or install covers before you apply power.

Capacitors, batteries, and resistors, such as tantalum capacitors and lithium batteries, might explode if you install them incorrectly. When you replace internal product parts, close the machine covers before you reapply power to the product.

### Product Safety Hazards

You are often the first person to recognize a potential safety hazard because you are a trained technician. Never assume a machine is completely safe. Always look for the following potential safety hazards:

- Power receptacles that are wired incorrectly.
- Evidence that the factory-supplied power plug is replaced with another plug. The replacement plug might be wired incorrectly.
- Missing or defective safety devices, such as shields over primary energy distribution circuits or moving parts, or safety labels.
- Design deficiencies.
- Shipping damage.
- Engineering changes that are installed incorrectly.
- Deterioration from age or environmental extremes.

Perform the following procedure when you discover a product safety hazard:

| Step | Action |
|---|---|
| 1 | Remove the power. |
| 2 | Lock out the power. |
| 3 | Notify your manager immediately. |
| 4 | Notify the customer about your action. Do not disparage the product or the manufacturer to the customer. |

## Safety Inspections

All IBM products at the time of their manufacture have safety items installed to protect the operators and service personnel from injury. Additional safety items are shipped as Engineering Changes to improve product safety.

Service personnel who have not been properly trained on safety practices or procedures can accidentally violate the integrity of safety items. IBM develops safety inspection guides to help you identify potentially unsafe conditions. You should use the guides after machine relocations and alterations and during Maintenance Agreement Qualification Inspections.

Safety inspection guides are part of the maintenance documentation on all products announced after July 1982. All other IBM products are supported either by tailored safety inspection guides or by the *General Safety Inspection Guide*.

The R009-1 Non-IBM Alteration/Attachment Survey form is also available for non-IBM alteration inspections. Contact management for assistance or guidance on these safety inspections.

A multivendor product safety inspection guide is available in the RETAIN database by searching on such keywords as SAFETY, MPM, or OEM. The TDR record is H137785.

## Working in Elevated Areas

Working at elevated levels presents several safety issues. If you are uncomfortable working in elevated areas, discuss your concern with your manager. If you anticipate working in an elevated area, accompany trained service representatives until you become comfortable with the environment.

Do not compromise safety when you work in elevated areas. If the proper equipment is unavailable, or if you cannot access the equipment safely, disengage until your safety concerns are resolved.
When you work in elevated areas, follow these safety guidelines:

## 1. Select the Right Equipment

**Ladders.** Use an approved non-conductive ladder made of fiberglass or wood. When the ladder is set up correctly (1:4 ratio base to height), the length should extend .91 m (3 ft) above the landing, with one-twelfth of the working length of the ladder overlapped with the fly section of the ladder. Refer to the service planning documentation for the correct requirements.

**Note:** Ladders longer than 5 m (16 ft) require two people to handle.

Before you set up a ladder, you should inspect it for defects or damage. You cannot wear leather-sole shoes when you work on a ladder. Your shoes should be clean and free from mud or grease. Use extra care around power lines, cables, and other potential overhead obstructions. You should block off or cone the area around the ladder.

Set up the ladder on a level surface and secure it at the top, middle, and bottom. When you climb a ladder, you must always have three points in contact with the ladder, either two hands and one foot or two feet and one hand. Carry your tools in a belt or hoist them. You should always face the ladder and keep your belt buckle between rungs to avoid reaching while you are climbing. Never use a step ladder as a straight ladder.

Never set up a ladder on a pole to access a piece of equipment. Use an aerial lift instead.

**Aerial Lifts.** A variety of aerial lifts are available, so be sure you understand operating and safety features for the specific lift you use. The vendor provides a user's manual and operating and safety instructions. Aerial lifts might have different features, but all require safety precautions. Table 5-2 shows some do's and don'ts for working in aerial lifts.

Table 5-2. *Rules for Working in Aerial Lifts*

**DO:**

- Inspect the lift for defects before operating it.
- Eliminate and avoid ground hazards like pot holes, debris, inclines, and traffic.
- Eliminate or avoid aerial hazards like overhead power lines and cables.
- Keep the basket or bucket to a minimum of 3 m (10 ft) from power lines.

**Note:** If the lift inadvertently contacts a power source, remain in the basket until the energy is isolated. Do not jump to the ground.

- Make sure the lift is chocked and coned off.
- Maintain firm footing and good housekeeping inside the basket.
- Tie off to the retaining basket, bucket, or boom ring when inside the basket, using only approved safety harnesses.
- Use only lifts with gated baskets or buckets to access roofs. The basket bottom must be at approximately the same level as the roof, with no gap between the basket and the edge of the roof.

**DON'T:**

- Use a lift for something other than its designated purpose.
- Exceed the manufacturer's load capacity.
- Tie off to an adjacent structure while working inside the basket or bucket.
- Use a ladder inside the basket or bucket.
- Stand on the basket railing to extend your reach.
- Climb a raised platform.
- Move the truck while the basket or bucket is raised.
- Climb over a basket or bucket railing to access a roof.

### 2. Choose the Safest Means of Access

**Roofs.** When you must access a roof, look for access within the building. Inside access is preferable to extension ladders and lifts. If you must work within 3 m (10 ft) of a roof's edge that has no railing or a wall that measures a minimum of 0.91 m (36 in.) in height, you must wear an approved, properly anchored fall-protection device. The basket bottom must be at approximately the same level as the roof. If you must access a roof with a lift, there should be no gap between the basket and the edge of the roof. Working on sloped roofs is discouraged. If you must work on a sloped roof, wear an approved, properly anchored fall-protection device.

**Poles.** Do not set up a ladder on a pole to access pole-mounted dishes. Use an aerial lift instead.

**Other Areas.** If the equipment is located on a canopy, building side, or other structure, you must inspect the area around the equipment to make sure it is structurally sound, stable, and able to handle the weight. Ask the customer or end user for this information. If you cannot obtain this information, disengage until you receive this information. You should also wear an approved, properly anchored fall-protection device. Do not walk on I-beams or on structures that look unstable or weak.

### 3. Consider Environmental Factors

Certain conditions present hazards that you must control or avoid when you perform service work at elevations. These conditions are:

**Weather.** Do not work on outside or elevated areas during lightning, heavy rain, snow, and heavy wind gusts in excess of 48.2 kilometers (30 miles) per hour. Use a fiberglass pole to clean snow and ice off a satellite dish.
**Night Work.** Do not work at elevated levels with ladders or aerial lifts or on roof tops at night unless sufficient light is provided.
**Potentially Hazardous Environments.** Do not work in confined spaces that have the potential to be oxygen deficient, have limited access, or are less than 3 m (10 ft) from energized power lines.

## Summary

IBM safety guidelines establish and help maintain a safe working environment. Follow safety guidelines and use common sense while working alone, working with power on, and servicing non-IBM products.

If you work in elevated areas, be sure to select the right equipment, choose the safest means of access, and consider the environmental factors.

Do not work in customer environments that expose you to safety and health risks. Follow the proper procedure if you see a potential safety exposure.

# Lesson 2. Personal Protective Equipment


Sometimes you must use personal protective equipment (PPE) to minimize exposure to hazards in the work environment. This lesson states the requirements for using personal protective equipment.

## Objectives

After completing this lesson, you should be able to identify the appropriate personal protective equipment for specific safety hazards.

## Controlling Exposure Hazards

Did you know:

- Flying or falling objects cause most industrial eye injuries?
- Contact with harmful substances, such as acids and bases, are the second largest cause of eye injury?
- Objects that fall on the toes and feet cause most foot injures?

Personal protective equipment can protect you from industrial injuries. You should wear personal protective equipment when there is potential exposure to chemical, physical, or mechanical hazards. You should also wear personal protective equipment when the ventilation, barriers, guards, enclosures, or other engineering methods do not control or eliminate the hazards.

The effectiveness of personal protective equipment depends on the wearer's willingness and ability to use and maintain it properly. For this reason, engineering and administrative controls are preferable to personal protective equipment.

## Using Personal Protective Equipment

You are required to wear personal protective equipment in certain customer environments. Hazard assessments identify the areas that require personal protective equipment and the type of personal protective equipment to use. Use only personal protective equipment that has been authorized by IBM or approved for use in your country. Personal protective equipment includes protective shields and barriers that provide eye, face, foot, hand, body, head, hearing and respiratory protection. When personal protective equipment is required, you should not perform operations without it.

Even when protective gear is available, you might want to move the equipment from a hazardous area before you perform the service tasks.

### Eye and Face Protection

All service representatives should carry safety glasses with them.  You must wear eye protection when there is potential exposure to hazards such as:

- Flying particles
- Airborne dust
- Compressed gases
- Sparks
- Metal fumes
- Chemical splashes
- Radiant energies (ultraviolet, infrared, laser)
- Molten metal

You should follow these rules to protect your eyes:

| Table 5-3. *Rules for Eye Protection* | |
|---|---|
| **When This Hazard Exists:** | **Wear:** |
| Flying objects | Safety glasses with side shields or detachable side protectors. |
| Electrical hazards | Safety glasses made of electrically non-conductive materials. |
| Lasers, infrared, ultraviolet, or intense radiant energies | Laser safety glasses or goggles with side shields or detachable side protectors. |
| Chemical splashes | Chemical splash goggles. Use a face shield when there is a high potential for chemical splash to the forehead, face, or neck. |
| Molten metal, flames, hot liquids, or cryogenic Materials | Goggles or safety glasses and a face shield. |

**Note：**Metal framed safety glasses are not allowed to be worn when working with electricity.

## Foot Protection

You must protect your feet when there is potential for foot injuries from hot, corrosive, falling, or rolling objects. You must also wear foot protection when there are sharp objects that might pierce the sole of your foot.

When foot hazards exist, wear safety shoes that are approved by the local regulatory agency, “Sturdy shoes” are recommended for most service work. Sturdy shoes fully enclose the foot with a durable abrasion-resistant upper and have stable, non-skid heels and slip-resistant soles.

Take special precautions where your shoes may have been contaminated in an environment with hazardous materials. Contaminated shoes may need to be cleaned or discarded.

### Hand Protection

You must wear appropriate gloves for protection from chemical effects (burns, irritation, skin absorption), severe cuts, lacerations or abrasions, punctures, thermal burns, or harmful temperatures. Gloves are one of the most effective tools that reduce exposure to chemicals. Many chemical substances are absorbed into the body with prolonged skin contact. You should carry protective gloves in your tool case at all times and wear them for procedures that expose you to skin contact with chemicals.

Protective gloves also prevent the development of dermatitis, which is the collective name for a variety of chemically induced skin conditions. Excessive skin exposure to solvents causes a type of dermatitis with symptoms of dry, cracked skin. The dermatitis occurs because the solvents eventually remove fats and oils from the skin like they remove grease and oils from machine parts. Some types of dermatitis are debilitating, heal slowly, and cause secondary infections. You should wear protective gloves to avoid excessive skin contact with chemicals.

You should also consider the thickness of the gloves. Thinner gloves, which facilitate the sense f touch with small parts, often allow solvents to break through when contact occurs for extended lengths of time. Thicker gloves, such as nitrile rubber gloves, probably offer the best protection. Nitrile rubber gloves are reusable. You should carry them in your tool case at all times.

Before you use any glove, even a new glove, you should visually inspect it for tears and worn spots. You can test for small holes by waving he glove in the air to inflate it, holding the sleeve, and watching to see if the glove deflates. If you have any doubt about the condition of a glove, you should discard it and obtain a new pair. Chemicals can contaminate the glove exteriors, so avoid touching your skin with gloved hands. After you remove gloves from your hands, do not touch the glove exterior.

There is a procedure for removing a contaminated glove. Roll it inside out from the arm to the fingers and start removing the second glove before you completely remove the first.

Don't wear gloves when you work on or around moving machinery.

**Latex Gloves.** Some workers are allergic to latex gloves and other products that contain natural rubber latex. They develop allergic reactions such as skin rashes, hives, nasal, eye, or sinus symptoms, asthma, and (rarely) shock. Whenever possible, you should wear non-latex gloves instead of latex gloves. Use cotton liners when latex gloves are required. Remove the gloves and wash your hands after you complete your work. If you encounter problems with latex gloves, contact IBM Occupational Health Services.

**Polyethylene gloves.** You can use polyethylene gloves with many toners, epoxies, inks, greases, and oils. When you work with solvents and other chemicals, examine the Material Safety Data Sheet (MSDS) to help select the gloves that are appropriate for the application. You should also consider the thickness of the gloves. Thinner gloves, which facilitate the sense of touch with small parts, often allow solvents to break through when contact occurs for extended lengths of time. Thicker gloves, such as nitrile rubber gloves, probably offer the best protection. Nitrile rubber gloves are reusable. You should carry them in your tool case at all times.

Before you use any glove, even a new glove, you should visually inspect it for tears and worn spots. You can test for small holes by waving the glove in the air to inflate it, holding the sleeve, and watching to see if the glove deflates. If you have any doubt about the condition of a glove, you should discard it and obtain a new pair. Chemicals can contaminate the glove exteriors, so avoid touching any of the skin with gloved hands. After you remove gloves from your hands, do not touch the glove exterior.

There is a procedure for removing a glove. Roll it inside out from the arm to the fingers and start removing the second glove before you completely remove the first.

Don't wear gloves when you work on or around moving machinery.

### Body Protection

Aprons, apron-coats, arm guards, coveralls, laboratory coats, and full-body covering provide body protection against potential hazards that exist in the work area.

Coveralls or laboratory coats help protect against dirt and minor chemical hazards. However, laboratory coats do not protect you from liquid chemicals.

You should wear aprons when there is potential for corrosive or irritating liquid spills or splashes on your body.

### Head Protection

You should wear approved head protection in areas where a potential for head injury from fixed or falling objects exists. Head protection is required when you work:

- Beneath others or under machinery, equipment, or materials that might fall, such as in confined spaces below ground level and in construction areas
- Under conveyors or machinery
- In areas that have a high probability for head contact with fixed or mobile objects (areas with low head room or overhead piping or valves, and construction areas where materials are moved overhead)

### Hearing Protection

Specific customer environments, work procedures, or recreational activities can occasionally produce a temporary ringing or fullness in the ears that is accompanied by a perceptible change in your sensation of loudness. Such a change is known as a temporary threshold shift, or TTS. Temporary threshold shift is not necessarily indicative of hearing damage in itself, but lifetime exposure to such noise levels can result in hearing impairment.

You should wear hearing protection in situations that cause a temporary threshold shift. In the United States, ear plugs are available from the Mechanicsburg Distribution Center. In other countries, consult your manager about obtaining hearing protection. Ear plugs have a noise reduction rating of almost 30, which means they reduce a given noise exposure by 30 dBA.

The instructions for ear plugs are on the package. As long as ear plugs are pliable and cleanable, you can reuse them. You wash ear plugs with warm water and ordinary face soap and let them dry. You should not use solvents or other strong cleaning agents. If you have an ear infection or hearing-related problem, consult a physician before you wear ear plugs.

In certain circumstances, ear muffs might be preferable to ear plugs. Consult your manager to obtain ear muffs.

If you experience a TTS at the conclusion of your work shift, or if you find that you must routinely wear hearing protection, you should inform your manager and request an evaluation by the IBM Occupational Health Services medical department that supports your area. You might be placed on a hearing conservation program with the area medical department. Enrollment in this program involves periodic hearing tests that detect changes in hearing.

## Summary

You should wear personal protective equipment any time you are exposed to chemical, physical, or mechanical hazards. You should also wear protective equipment when ventilation, barriers, guards, enclosures, or other engineering methods do not control or eliminate hazards.

Personal protective equipment includes safety glasses, goggles, ear plugs, gloves, and other devices that protect your body from chemicals, debris, noise, and other hazards.

# Lesson 3. Cable Installation and Maintenance


Activities associated with installing and maintaining cables can cause injury to the back and other parts of the body. This lesson provides safety guidelines for removing and installing floor tiles and laying cables.

## Objectives

After completing this lesson, you should be able to identify the safety exposures associated with installing and maintaining cables

## Safety Exposures

Most data processing and information technology (I/T) equipment uses cables to connect devices to electrical power and communicate with each other. Factors, such as cable type and physical size, can affect cable installation and equipment maintenance. You should be aware of the factors that can affect personal safety.

Electronic and I/T equipment is designed with personal safety in mind. However, the manufacturer has little control about where the customer will install and maintain the equipment. Each customer site is different and can have hidden safety exposures.

Some of the common safety exposures and concerns associated with cable installation and maintenance are:

- Back injury
- Cuts, lacerations, or punctures to fingers, hands, arms, knees, or legs
- Dirt or foreign objects in the eyes
- Falling into an opening in a raised floor
- Laser beam exposure to the eyes
- Electrical shock

You can observe the environment and apply standard safety practices to minimize exposures. This is especially important when you work at a facility with a raised floor. The raised floor introduces many exposures. You should always remove tile from a raised floor and never try to balance the tile and work under the floor at the same time. The floor panels have been cut to accommodate the equipment cables and usually have sharp edges. If tile cutting is performed at the computer equipment site, the cuttings can drop into the raised floor openings. These cuttings can become imbedded into the outer covering of the cables that are installed and routed under the floor. The cuttings, as well as other dirt and debris, might also become airborne as floor tiles are removed from a raised floor. You should use appropriate gloves, safety glasses, and lifting techniques.

Safe work habits and good observation are essential when you install cables or perform maintenance work that involves cables. You must disconnect or turn off the correct electrical power and perform the installation and maintenance procedures for the equipment.

### Installing Fiber Optic Cable

Fiber optic cables are easy to install because they are small, lightweight, and flexible. Sometimes the cable ends and the protective interlocks are damaged. The cable damage might expose or release visible laser light even when the cable is not plugged into the appropriate device or patch panel. You should never look directly into a fiber optic cable. During the installation procedure, you should not connect a fiber optic cable to an optic source until the routing is complete.

Another concern is the glass fiber. The glass fiber is a possible hazard if you install or repair the connectors on site. The fiber is small and difficult to see, but it can easily penetrate the skin like a wood or metal sliver. If you work with glass fiber, you must perform the appropriate procedures and remove any scrap or glass cuttings.

### Suction Lifting

Use only the tile lifting tool that the tile manufacturer recommends. Using suction lifting devices on tiles that have an uneven or contaminated surface can be hazardous. A tile might drop suddenly if any suction leakage occurs, and you might receive an injury from the sharp edges of the tile when it falls. Inspect the suction cups on the lifting tool for cuts or damage that could cause the vacuum to leak.

## Summary

You can observe the work environment and apply standard safety guidelines to avoid the hazards associated with installing and maintaining equipment. Some common hazards originate with raised floors, fiber optic cables, and suction lifting devices. The floor panels of raised floors can have sharp edges and debris imbedded in them. Damaged fiber optic cables can emit laser light even though the cable is unplugged, and cable fibers might penetrate the skin.

The safety guidelines include using safety glasses, gloves, and lifting techniques. You should also never look directly into a fiber optic cable until all routing is complete. You should always perform the product manufacturer's installation and maintenance procedures.

# Lesson 4. Motor Vehicle Driving Safety

If you are like many IBM employees, driving a motor vehicle may be the most potentially hazardous activity that you will ever perform. Each of us has a personal responsibility to help prevent accidents and keep our roads as safe as possible by driving safely and considerately.

# Objectives

After completing this lesson, you should be able to identify and then practice in your day-to-day activities the principles of Safe Driving.

# Decision Driving

When you drive, are you aware of what's going on all around you? Do you anticipate what the driver in front, to the side, or behind you may do? Do you see the potential hazards and plan how you will react to them? Always? Or, like the rest of us, only sometimes?

The principles of safe driving can help you avoid emergencies. Accident-free driving isn't just a matter of luck or skill. In large part, it depends on the decisions you make and the actions you take based on those decisions. Driving skill is important, but it doesn't make other drivers more attentive. It doesn't make ice less slippery, or improve visibility in fog. Safe driving complements the driving skills and knowledge you already have. It improves your ability to see hazards before they become dangerous, and to decide on the best course of action to avoid them.

## Principles of Safe Driving

### 1. Expand your look-ahead capacity

- Glance ahead frequently to see where you will be in the next8-10 seconds
- Check the center of your driving lane well ahead to make sure your vehicle stays centered in its lane
- In the city, look at least 2 blocks ahead. Look for traffic lights, pedestrians, moving vehicles and hazardous conditions
- On highways, look as far ahead as possible. Watch for hazardous conditions such as fog, ice patches, flooded areas, or debris on the road
- Watch for vehicles merging into your lane
- Drive at a speed that allows you to stop within the distance covered by your headlights

### 2. Size up the whole scene

- Stay aware of the road, weather, and traffic conditions by shifting your vision to the front, sides, and rear of your vehicle
- Never stare at anything for more than 2 seconds
- Check your rear view mirror frequently - at least every 5-10 seconds
- Keep your eyes moving in as wide an area as possible, watching for the unusual
- Watch for moving vehicles about a half-block before you come to intersections, driveways, or parking areas

### 3. Signal your intentions early

- Tap the horn to alert others of your presence (avoid long blasts, don't startle or upset people)
- Signal when you move your vehicle in any direction that might affect others
- Initiate your signal at least 8-10 seconds before turning, changing lanes, entering or exiting expressways, or passing
- Warn drivers behind you about road or driving conditions by tapping your brakes so that your brake lights alert them
- Turn on your headlights as darkness approaches, not only to see, but to let others see you

### 4. Plan an escape route

- Never let your own safety depend entirely on other drivers
- Plan an escape route that leaves you an "out" if other drivers make a mistake
- Have time and room to take decisive action by speeding up, slowing down, or moving to either side

For further information you may take the on-line IBM Decision Driving course (Course Code DDWBT001) on the web. Any employee classified as a “Frequent Business Driver” must complete this course once every three years. Canadian employees driving IBM-owned or IBM-leased vehicles are required to complete the course annually. To enroll, use either one of the following two methods:

IBM U.S. Employees
- Visit the ITS Skills and Development website at http://trgweb.atlanta.ibm.com/

IBM Canada Employees and others
- Visit the IBM Global Campus website at http://w3.education.ibm.com

In addition to defensive driving techniques, when driving on IBM company business, you must :

- Comply with all applicable motor vehicle laws at all times. This includes maintaining your drivers license and proper vehicle registration and obeying road signs.
- Use driver and passenger shoulder and lap belts (mandatory for all vehicle occupants).
- Resolve any traffic and/or parking citations.
- Ensure proper maintenance and repair of the vehicle. Conduct a safety check of the vehicle (tires, mirrors, windshield wipers, lights, defroster, brakes, seat belts, etc.) prior to each day’s use.
- Report any accident promptly (within 24 hours) and completely.
- Notify your manager if a medical condition may affect your ability to drive safely, you receive a traffic citation or your driving license is suspended or revoked.

## IBM Guidelines for Safe Use of Cell Phones in Motor Vehicles

Millions of people worldwide use cell phones daily to conduct business and personal affairs from virtually anywhere, including from within their own vehicle. The use of cell phones when driving a motor vehicle has been accompanied by concerns over the potential risks of being involved in a motor vehicle crash. This increasing public concern over the safety of using cell phones while driving has been reflected in the growing number of legislative initiatives limiting their use in many countries and jurisdictions.

As an IBMer, it is important for you to be aware of the risks associated with using a cell phone in motor vehicles, and you should be aware of IBM's guidelines on their safe use. Most importantly, IBM wants you to put your safety and the safety of others above all else. IBM does not approve of any use of cell phones, or other distractions, which could create a potential hazard. Follow these guidelines:

**Safe driving is your first responsibility.** When driving a motor vehicle, safe driving is your first and most important responsibility. Good judgment must be exercised at all times. This requires that you remain alert, cautious, courteous and obeying all traffic laws.

**Using a cell phone while driving is discouraged.** When a phone conversation is necessary, pull off to a safe location. Select an area which will not jeopardize your safety or cause a hazard for other drivers. Avoid pulling to the shoulder of freeways and other busy roads.

**Know and follow the rules in your country, state or jurisdiction.** It is IBM policy to meet regulatory requirements wherever IBM does business.

**Hand-held vs. hands-free.** Using a hands-free device while driving is not without risk. While a hands-free device is preferred over hand-held, a hands-free device does nothing to avoid the most frequently cited cause of motor vehicle crashes -- mental distractions.

**Do not engage in stressful or emotional conversations.** Stressful or emotional conversations and driving do not mix. They are distracting and can be dangerous when you are behind the wheel.

## Summary

Driving is an activity that most employees do every day. According to the National Safety Council, more than 42,000 people lose their lives in motor vehicle crashes each year and two million more suffer disabling injuries. Safe Driving means not only taking responsibility for yourself and your actions but also keeping an eye on "the other guy." By practicing the principles of Decision Driving you will minimize your chances of injury.

It is also important to follow some basic IBM policies to ensure your safety. Be sure to wear your seat belt. Make sure your vehicle is maintained to good operating condition by inspection it daily. Let your manager know if you have a medical condition or other issues that prevent you from driving at work.

IBM does not approve of any use of cell phones, or any other distractions, which could create a potential hazard while driving. Using a cell phone while driving is discouraged. When a phone conversation is necessary, pull off to a safe location.

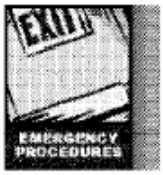
# Module 6. Emergency Response Programs


You must be prepared to respond to emergency situations each time you provide service at a customer's facility. If an injury, illness, or accident occurs, you must report the incident and help with the investigation. This module provides guidelines for preparing for emergencies and reporting work-related injuries, illnesses and incidents.

The lessons in this module are:

Lesson 1. Emergency Procedures
Lesson 2. Reporting Safety Incidents
Lesson 3. Fire Safety
Lesson 4. Catastrophic Events

## Lesson 1. Emergency Procedures




The best emergency preparation is to become familiar with the work environment. This lesson describes the safety precautions for working on or around hazardous equipment.

### Objectives

After completing this lesson, you should be able to identify emergency preparation tasks.

### Emergency Preparedness

The first emergency preparation task is to know what to do in the event of an emergency. At a customer location, you should learn about any special emergency alarms or procedures. If an emergency requires evacuation, you should know the location of normal and emergency exits, and know the routes to at least two exits.

Several factors determine the number, location, and capacity of exits. Large, continuous areas in floors and buildings usually require a minimum of two exits. When you work in a large room, find the emergency exits and the normal exits. The customer should observe the following exit guidelines:

- Travel paths to exits should be unobstructed.
- Exits should be readily identifiable and accessible.
- Exit doors should open in the direction of travel.
- Devices or alarms on doors should not impede or prevent the emergency use of an exit.

- Exit doors should not have locks or fastening devices that might prevent escape.
- Primary and secondary exits should be available in case of an emergency.

You should locate the emergency power shutoff and the nearest fire extinguishers before you begin working on hazardous equipment. You should ask if the customer uses a public address system, fire alarm, or building evacuation alarm to announce emergency evacuations. You should also locate the manual fire alarm stations. Ask if there is a list of emergency telephone numbers and where the list is located.

If you will be working on hazardous equipment, arrange for someone to stay with you. This person can help you or call for help if an accident occurs.

### Summary

You must prepare for emergency situations when you work at a customer's facility. You should know how you will be notified of an emergency situation and the location of the building exits, emergency power shutoff, fire extinguishers, and alarms. You should also arrange for someone to stay near you while you work on hazardous equipment.

## Lesson 2. Reporting Safety Incidents


It is important to promptly report work-related injuries, illnesses, and accidents so they can be investigated and corrective actions taken to prevent similar events from happening in the future. This lesson explains the procedures for reporting safety illnesses, injuries, and other incidents.

### Objectives

After completing this lesson, you should be able to identify accident and incident reporting criteria.

### Reporting Procedure

Any serious accident (injury, illness, property damage, harm or loss) or near accident that involves any of the following circumstances must be reported immediately to IBM Global Occupational Health Services:

- A fatality
- Permanent disability or hospitalization of one or more persons
- Injury or illness to more than one person
- Radiation exposure
- Electrical shock
- Chemical exposure
- Significant fire or property damage

**Note:** If an accident involves an IBM product, you must also report the incident to Product Safety management within 24 hours. For more information about product safety incidents, refer to the “Reporting Product Safety Incidents” lesson in Module 3 of this workbook.

You must also report environmental incidents, such as chemical spills, that might affect the health and safety of employees or the community. Report any other accident or situation that involves equipment materials, processes, or practices used within IBM that might be helpful in avoiding a repeat occurrence.

You must include the following information in a safety incident report:

- Employee's names, serial numbers and job assignments
- Brief description of the incident
- Extent of any injuries
- Date of the incident
- IBM contact person's name, address, telephone number, and Lotus Notes or Internet ID

If you are injured or become ill because of your work, you must notify your manager, who will report your situation to the appropriate reporting center in your country. The reporting center in the United States is the National Occupational Injury and Illness Reporting Center (NORC). A representative of the reporting center requests information about the injury or illness and determines whether the injury or illness should be reported to a national regulatory agency. The representative also forwards a report to the appropriate manager and the regional IBM Occupational Health Services staff.

Your manager investigates the incident to establish the cause and provides the necessary corrective action. IBM and the reporting center require the manager to notify other people and agencies about the safety incident investigation.

For information about safety incidents involving products, refer to the "Reporting Product Safety Incidents" lesson in Module 3 of this workbook.

### Summary

You must immediately report any accident or near accident that involves a fatality, permanent disability or hospitalization of one or more persons, injury or illness to more than one person, significant exposures to radiation, electricity, or chemicals significant property destruction. You must also report environmental incidents, such as chemical spills, that might affect the health and safety of employees or the community.

If you are injured, you should report the incident to your manager, who reports the injury to the national reporting center in your country. Your manager also investigates the incident and provides corrective action. Prompt reporting of work-related injuries and illnesses helps ensure employees receive prompt and appropriate medical treatment.

## Lesson 3. Fire Safety


Fire is the most common emergency and poses the greatest potential threat to life and property. This lesson describes emergency procedures for evacuating a building safely during a fire or during the release of toxic chemicals from a fire protection system.

## Objectives

After completing this lesson, you should be able to identify the most common fire extinguishing systems and their characteristics.

## Safety Precautions

Your primary concern is always the safe evacuation of yourself and others. You should know the following information before you provide service at a customer's site:

- Evacuation procedure
- Type of fire protection system
- Safeguards for working near the fire protection system detector or discharge heads

Do not reenter an affected area until the customer is certain that the area is safe.

## Fire Extinguishing Systems

Customers use a variety of fire protection systems and extinguishing agents, such as water, halon, carbon dioxide, FM200®, and Inergen®.

**Water.** Water is the primary fire extinguishing agent in many buildings. Water-based systems cool the reaction to the point that it is no longer sustainable, or they remove enough oxygen to inhibit combustion and smother the reaction.

Water is not a hazard, but if it comes in contact with electrically charged components, it becomes a significant safety threat independent of the fire. Water-based systems and extinguishers are not recommended for data centers and other areas that operate electrical equipment. However, water-based systems are commonly used in some countries and might be required by some fire codes.

**Halon.** The fire extinguishing mechanism of halon agents involves a chemical reaction that causes halon to interfere with the combustion process and inhibit the flame chain reaction. Halon 1301 decomposes and forms compounds that are toxic to humans during a fire. The products of decomposition are hydrogen bromide, hydrogen fluoride, and bromine. Halon is an ozone-depleting agent. Most customers have reduced or eliminated halon from their fire protection systems.

Avoid exposure to halon and its products of decomposition. Exposure to halon at concentrations above 10% can cause dizziness and impaired coordination. Halon causes loss of consciousness at high concentrations.

**Carbon Dioxide.** Carbon dioxide ($CO_2$) extinguishes fires by reducing the oxygen content in the environment to a level that does not support combustion. Carbon dioxide is an asphyxiant. It can cause loss of consciousness at exposures above 9%. Exposures to higher concentrations of carbon dioxide are sometimes fatal.

Carbon dioxide extinguishing systems are not recommended in occupied spaces because of the safety concerns. When carbon dioxide is used in an occupied space, special precautions, such as predischarge

alarms, discharge time delays, and manual overrides, must be used to reduce the risk to people. Carbon dioxide extinguishing systems are normally used in data centers that have raised floors or in local application systems.

**FM200®.** FM200 is the trade name for a synthetic compound designed to replace halon. FM200 is similar to halon; however, FM200® has no potential for ozone depletion, but it can cause global warming. FM200 has the same physical hazards and precautions as halon. FM200® is suitable for areas that require room flooding and under floor flooding systems.

FM200 is suitable for areas that require room flooding and under floor flooding systems.

**Inergen®.** Inergen® agent is a mixture of the following inert oxygen-diluting gases:

- Nitrogen, approximately 52%
- Argon, approximately 40%
- Carbon dioxide, approximately 8%

Inergen® is suitable for occupied spaces. It is not an ozone-depleting agent, and it does not cause global warming.

Like carbon dioxide, Inergen® gas extinguishes fire by lowering the oxygen content below the level that supports combustion. But there is one important difference. Unlike carbon dioxide, when Inergen® agent is discharged into a room, it introduces the proper mixture of gases that still allow a person to breathe in a reduced-oxygen atmosphere. Exposure should be minimized. Inergen® is suitable for automated tape storage centers that need room flooding and under floor-flooding systems.

## Summary

You should know the customer's evacuation procedure, fire protection system, and safeguards for working near the fire detectors and extinguishing system discharge heads.

Some fire extinguishing agents are water, halon, carbon dioxide, FM200®, and Inergen®. There are environmental concerns regarding halon and FM200®. Most customers do not use halon because it is an ozone-depleting agent. FM200® is not an ozone-depleting agent, but it does cause global warming. Inergen® is not an ozone-depleting agent, and it does not cause global warming.

FM200® and Inergen® are suitable for automated tape storage centers that need room flooding and under floor flooding systems. Water is not recommended for data centers and areas that operate electrical equipment. Carbon dioxide is not recommended for occupied areas because it is an asphyxiant that causes loss of consciousness at exposures above 9%.

# Lesson 4. Catastrophic Events

Recent events require all of us to be even more vigilant than usual in assessing the work environment to help ensure that it is safe, not only for ourselves, but also for our customers.

## Objectives

This section is intended to reinforce IBM practices regarding working in customer environments in light of recent catastrophic events.

## Procedures

You should always be familiar with the safety and health requirements at any customer location where you work. Be alert and attentive to any potential safety or health hazards (blocked emergency egress, tripping hazards, etc.) and identify these concerns to the customer as appropriate.

If customer employees are wearing personal protective equipment in the area(s) accessed by IBM, do not enter the area before contacting IBM management and Global Occupational Health Services (GOHS)

In the event that a known or suspected chemical/biological agent incident has occurred:

- Do not enter the effected area
- Inform your manager immediately
- Enter the affected area only after it has been determined not to be contaminated.
- Do not handle equipment or parts until it has been determined that they are not contaminated.
- Use of non-latex, unpowdered gloves is optional in areas that are not known to be contaminated. Gloves are listed in the tools catalog and can be ordered through your local parts center.

If you have been in a facility where the customer later identifies either a positive finding of chemical/biological agent contamination or places employees on preventative antibiotics, notify your manager and GOHS immediately.

Catastrophic events resulting in contamination can impact a machine's reliability and performance. Any damage will be dependent on the type of substances to which the IBM machine and its attached I/O are subjected. The effects on hardware reliability can appear any time from the first power-on cycle (time zero) to years later as the contamination interacts with electrical/electronic power, normal office humidity, secondary contamination (e.g. normal office dust/dirt), and normal service actions to cause intermittent and/or solid failures.

There is no safe/reliable way to clean a machine in a commercial environment and insure the original reliability will be restored. In all cases the cleaning operation will decrease the hardware reliability performance because of the additional wear cycle on connectors, the possible ESD (Electro-Static Discharge) damage in handling the system/parts during cleaning, the new additional contamination from moving the materials around during cleaning and/or the new contamination from the cleaning materials, process, or operation. For further information see :**Maintenance Acceptance Procedures**.

## Summary

Be knowledgeable of what you should do in the event that you encounter a situation where some type of catastrophic event has occurred. The IBM GOHS organization in partnership with line management and other staff groups is available to assist you.

# Module 7. Environmental Issues


IBM policy is to protect the environment and meet or exceed all applicable environmental laws and regulations. This module presents IBM procedures for recycling products, disposing of wastes, controlling polychlorinated biphenyls (PCBs), and moving dangerous goods.

The lessons in this module are:

Lesson 1. Recycling and Waste Disposal
Lesson 2. Polychlorinated Biphenyl (PCB) Handling
Lesson 3. Transporting Dangerous Goods

## Lesson 1. Recycling and Waste Disposal


This lesson explains the IBM recycling and waste reduction programs.

### Objectives

After completing this lesson, you should be able to identify the provisions of the IBM recycling and waste reduction programs.

### IBM Recycling Program

Materials and parts recycling is an important component of the IBM pollution prevention and waste reduction programs. Recycling also provides a source of revenue and expense reduction for IBM.

The IBM recycling program recycles parts that were formerly disposed of locally. Use your country's procedures to send parts to the designated reutilization center for recycling.

**Note:** Chemical items, such as lubricants, cleaners, some toners, and paint, are excluded from this program. Service personnel can share field use materials and should always use up the materials so that the containers are empty.

#### Handling and Disposing of Cathode Ray Tubes

A cathode ray tube (CRT) consists of a highly evacuated glass envelope that must be handled with extreme caution. Unsafe and careless handling of CRTs can cause the tubes to implode. Some tubes, when broken, merely fill with air and otherwise remain intact, while other tubes of matching design and construction implode violently under the same test conditions. Tests have indicated that an implosion is more likely to occur if the “bell” of the tube is impacted rather than the neck.

You should wear safety glasses and long-sleeve clothing when you handle CRTs.

Cathode ray tubes must be enclosed when they are received, transported, or moved from one area to another. If they are shipped in a carton, they must be in the original carton or one of equivalent strength, and they must be securely sealed to prevent accidental opening. Original or equivalent packing material and forms must be placed inside the carton to give the tube the proper support and protection. If tubes are transported in a unit or as a part or component of equipment, the equipment must be able to contain the glass fragments if an implosion occurs.

Stack cathode ray tubes according to the directions on the manufacturer's carton, or with the faceplate (viewing surface) down. Stack cartons no more than two high.

Cathode ray tube storage areas should be located away from the normal flow of material-handling equipment and pedestrian traffic. Storage areas must also be dry to ensure that cartons do not absorb moisture and collapse.

Ensure that the CRT has been discharged of all stored potential that might exist on the tube's anode button or base socket pins, and the capacitor in the high-voltage supply.

**Note:** Some cathode ray tubes contain a conductive coating on both the inside and outside surfaces to form a capacitor. A second capacitive charge builds up in some tubes following the original discharge. It is important to discharge each tube a second time immediately before removal.

Do not handle cathode ray tubes by the neck alone. The neck is the weakest part of the tube and it is easily broken. Always handle a tube with two hands. When a CRT is shipped with a lifting strap, this strap should be used to remove the tube from the shipping container or to place the tube into a shipping container.

Avoid placing a tube on a table or bench when there is a possibility that the tube might roll. If it is necessary to place a tube anywhere except in its carton, a piece of felt or other soft material should be placed under it to avoid scratching the glass. Place larger tubes vertically on their faces, and not on their sides to prevent the possibility of rolling. Cathode ray tubes should be placed in the carton with the large face end up and the neck down. Be sure that the weight of the tube is not resting on the neck. The container should be sealed securely with strong tape and, to prevent tipping, turned over so the tube is positioned face down.

You should not disarm cathode ray tubes. Tubes are disarmed at the IBM reutilization center or by the IBM-approved recycling and disposal vendor.

Do not dispose of CRTs locally. Return CRTs and plasma displays to the field location for return through the IBM Used Parts Return process or the IBM recycling program established in your country.

### Chemical Waste Disposal

You cannot dispose of chemicals, chemical wastes, or items contaminated with chemicals, such as rags and parts, in general trash or at a customer's location. You perform the IBM procedure for chemical disposal in your country and send all items to an IBM-approved treatment or disposal facility.

You must follow the procedures in national, regional, and local codes to dispose of cements, paints, sealers, lacquers, and cleaning fluids. If you have questions about disposal, review the Material Safety Data Sheet (MSDS). If you require an MSDS for a material, contact your IBM chemical coordinator or your manager.

**Note:** Refer to your country appendix for battery disposal instructions. For details on chemical disposal, consult your business unit's environmental or chemical coordinator or your country's Real Estate and Site Operations (RESO) procedures.

## Summary

The IBM recycling program includes recycling parts and materials except chemical items, such as lubricants, cleaners, and paint. Service personnel can share field use materials and should always use up the materials so that the containers are empty. Cathode ray tubes (CRTs) must be handled with extreme caution because unsafe handling can cause the tubes to implode. You should not disarm CRTs. The IBM reutilization center or the IBM-approved recycling and disposal vendor disarms the tubes. You should not dispose of CRTs locally. Return CRTs to the field location for return through the IBM Used Parts Return process or the IBM recycling program established in your country.

Send chemicals, chemical wastes, or items contaminated with chemicals to an IBM-approved treatment or disposal facility. Do not put chemical items in general trash or leave them at a customer's location.

# Lesson 2. Polychlorinated Biphenyl (PCB) Handling


This lesson explains the procedure for identifying materials that might contain polychlorinated biphenyls (PCBs). It also presents the proper procedure for handling and disposing of these materials.

## Objectives

After completing this lesson, you should be able to identify the procedure for disposing of capacitors that spill or leak.

## Polychlorinated Biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) are a class of chemical compounds that were used as dielectrics in capacitors and transformers because of their low flammability characteristics. PCBs are banned because they resist decomposition when they are released into the environment and because they can accumulate in animal tissues.

The relative toxicity of PCBs to people and the environment is debatable. However, ingesting or inhaling substances that contain high concentrations of PCBs can result in liver damage over time. The skin can absorb PCBs, which accumulate in certain animal and human tissues. Repeated and prolonged skin contact can also cause chloracne, which is a type of dermatitis. When you suspect the presence of PCBs, use caution and wear protective gloves while you perform service tasks. Wash your hands with soap and water after you complete the service tasks.

If a capacitor spills or leaks, use the following procedure to dispose of the unit:

1. Allow the liquid to cool.
2. Wear rubber or plastic gloves.
3. Do not allow your skin or clothing to contact the liquid or any substance that is contaminated with the liquid.
4. If skin contact does occur, wash the affected area thoroughly with soap and water. If eye contact occurs, flush eyes immediately with water for 15 minutes and contact a physician.
5. If clothing contact occurs, rinse the affected areas with water. Launder or dry clean the clothing as soon as possible.
6. Absorb any spillage or leakage with a cloth or paper towel.
7. Clean the affected area with a dry cloth or a cloth that contains soap and water.
8. Put the defective device, cleanup materials, and used gloves in a plastic bag, and tie and seal the bag tightly.
9. Return the sealed or tied bag to the field location. Identify the bag as **PCB Return**.
10. Do not mix any other parts with this returned material.
11. Indicate **PCB Return** on the return carton and attach the PCB label.

**Note:** See your country appendix for your procedure.

Important PCB Dates:

01/01/77 All new IBM equipment was shipped free of PCBs.
06/01/77 All reconditioned IBM equipment was shipped free of PCBs.
07/01/79 All IBM machine maintenance parts were free of PCBs.

You cannot positively identify PCBs, so you should treat all used and defective capacitors that contain insulating oil as if they are PCB capacitors and return them. Follow IBM procedures in your country for disposing of IBM PCBs. No special precautions are necessary for disposal of non-PCB components.

Use caution to prevent placing used parts in a location where they are hazardous to other personnel. Do not leave used parts in the customer's office. Return used parts to the field location for scrap.

### Summary

Polychlorinated biphenyls (PCBs) are a class of chemical compounds that were formerly used as dielectrics in capacitors and transformers. PCBs are now banned because they resist decomposition and can accumulate in animal tissues. Use caution and wear protective gloves if you suspect the presence of PCBs. Follow IBM procedures in your country when you dispose of IBM PCBs.

## Lesson 3. Transporting Dangerous Goods


This lesson explains how to ship dangerous goods. It also provides basic shipping classification information for transporting dangerous goods.

## Objectives

After completing this lesson, you should be able to:

- Identify four types of dangerous goods
- Identify the procedure for handling batteries

## Transportation Information

Government agencies control the movement of hazardous materials or dangerous goods depending on the mode of transportation. All agencies require that trained, tested, and certified employees classify, package, mark, label, and document a dangerous goods shipment. IBM requires retraining every two years for employees who handle dangerous goods shipments. Completing this general safety course does not meet the IBM training requirement.

Failure to comply with the training requirement can result in fines or imprisonment for dangerous goods employers or employees. IBM uses the following tools to control dangerous goods shipments:

- *Hazardous Materials Shipping Manual*
- Corporate Magnetized Machine Type and Part Number databases at:

http://w3-9006.ibm.com/isc/distribution/hazmat3.nsf

**Note:** If viewing this file via Adobe Acrobat Reader and if connected to the network, you may click the link to access this information now.

Select **Corporate Magnetic Database** by **Machine Type** or **Corporate Magnetic Database** by **Part Number.**

The Material Safety Data Sheet (MSDS) can help a certified user prepare hazardous materials for shipment. Hazardous materials, or *dangerous goods*, are not limited to chemicals. They also include:

- Magnetized materials that are shipped by air
- Radioactive materials
- Articles pressurized pneumatically (gas springs)
- Some types of batteries (especially lead-acid batteries or other batteries that can spill)

## IBM Chemicals

IBM requires a review and approval of all chemicals that are used in its operations. A group of qualified medical, industrial hygiene, chemical management and safety professionals review the toxicity of a chemical and the circumstances involved in its application before approving its use.

### Handling Procedure for Batteries

To prevent short circuiting and heat buildup during storage and transport, you must use tape to cover the metal (+ and -) terminals on any battery that is not individually wrapped or included in a battery pack. You must not tape over any battery type information so the batteries can be easily sorted at the receiving location. You can tape coin size batteries by putting them side by side between two strips of clear tape.

Do not pack, store, or ship used batteries in tightly sealed containers. This can cause cell shorting and heat buildup.
You must store batteries in a dry place away from combustibles. Store only similar battery types and chemical types together. For example, you store nickel cadmium with nickel cadmium. You must individually wrap corroded or damaged batteries. You should search the country appendix for specific shipping instructions.

## Summary

Dangerous goods include chemicals, magnetized materials that are shipped by air, radioactive materials, articles pressurized pneumatically, lead-acid batteries, and batteries that can spill. Government agencies require that trained, tested, and certified employees classify, package, mark, label, and document a dangerous goods shipment.

You must use tape to cover some battery terminals to prevent short circuiting and heat build-up during storage and transport. Do not pack, store, or ship batteries in tightly sealed containers. Refer to your country appendix for additional instructions about transporting dangerous goods.

# Appendix A. Product Certification Marks and Hazardous Chemical Labels

Table A-1 identifies the *mandatory* product certification marks for the United States and Canada.

Table A-1 (Page 1 of 2). *Product Certification Marks*

| **Information Required on All Information Technology (I/T) Equipment Product Labels** | **United States** | **Canada** |
|---|---|---|
| Safety certifications: Minimum of one of these logos on the product label | CSA/NRTL **1**<br>CSA NRTL/C **3**<br>CCSAus **3a**<br>UL **4**<br>cULus **6**<br>ETL **7**<br>TUV/NRTL **9** | CSA **2**<br>CSA NRTL/C **3**<br>CCSAus **3a**<br>cUL **5**<br>cULus **6**<br>cETL **8** |
| Product Type, Model, Serial | Yes | Yes |
| Voltage or<br>Voltage Range or<br>Voltage Range | 120 V ac<br>100-125 V ac<br>100-240 V ac | 120 V ac<br>100-125 V ac<br>100-240 V ac |
| Frequency in Hertz | 60 Hz or 50-60 Hz | 60 Hz or 50-60 Hz |
| Compliance Statements:<br>Required compliance statements on product label regarding product emissions | This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference. (2) This device must accept any interference received, including interference that may cause undesired operation. **10** | This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference. (2) This device must accept any interference received, including interference that may cause undesired operation. **10** |
| FCC Identifier | FCC ID: XXX 1234 ABC | FCC ID: XXX 1234 ABC |
| Industry Canada Identifier:<br>Class A or Class B required | Not required | Canada ICES/NMB-003<br>Class/Classe A<br>or<br>Canada ICES/NMB-003<br>Class/Classe B |
| **Additional Information Required on Specific Products** | **United States** | **Canada** |
| Visual Display and Laser Products | Certified to comply with DHH Rules 21 CFR Subchapter J CDRH | Certified to comply with DHH Rules 21 CFR Subchapter J CDRH |
| Telephone Line Attachment and ISDN Line Attachment Products | Complies with FCC Part 68 FCC Registration label with Number: XXXXXX-12345-XX-X | Industry Canada Certification Number: 1234-5678-X<br>Load Number (LN):X **11** |
| Laser Products<br>A label identifying the class of laser (Class 1, 2, 3, or 4) and its hazard warnings. | Yes **12** | Yes **12** |

The highlighted numbers (for example, **1**) correspond to the product certification marks.

| Table A-2. *Hazardous Chemical Labels* | | |
|---|---|---|
| **Hazardous Chemicals for Maintenance** | **United States** | **Canada** |
| Label Information | Label lists:<br>_ Chemical name from MSDS<br>_ Hazards<br>_ Precautions<br>_ First aid measures | Yes **13** |

The highlighted number **13** corresponds to the hazardous chemical labels.

These are product certification marks for the United States and Canada. Refer to Table B-1 in this appendix for an explanation of these product certification marks.


**CSA/NRTL Mark**

The CSA mark is registered in Canada and other countries. If the CSA mark appears with the letters *NRTL*, it means that the product is CSA-certified for the United States market only. **1**

**CSA Mark**

If the CSA mark appears alone, it means that the product is certified for the Canadian market only. **2**


**cCSAus Mark**

If this mark appears with the letters *c* and *us*, it means that the product is certified for both the U.S. and Canadian markets. **3a**


**CSA NRTL/C Mark**

If the CSA mark appears with the letters *NRTL/C*, it means that the product is CSA-certified for the United States and Canadian markets. **3**

**UL Listing Mark**

Underwriters Laboratories (UL) is a third-party testing laboratory. If a product carries this mark, it means that UL found that samples of this product met UL's safety requirements for the United States market only. **4**

**cUL Listing Mark**

This UL mark is applied to products that are certified for the Canadian market only. **5**

**cULus Listing Mark**

This UL mark is applied to products that are certified for the United States and Canadian markets. **6**

**ETL Mark**

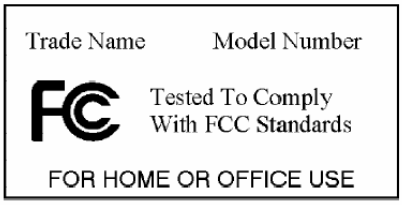
A product carrying this mark has been certified by Intertek Testing Services (ITS) and meets the minimum requirements for United States product safety standards only. **7**

**cETL Mark**

A product carrying this mark has been certified by Intertek Testing Services (ITS) and meets the minimum requirements for Canadian product safety standards only. **8**


**TUV/NRTL Mark**

TUV is a nationally recognized third-party testing laboratory (NRTL). A product carrying this mark has been tested and complies with applicable United States national safety standards only. **9**




**FCC Mark**

A product carrying this mark has been tested and complies with United States Federal Communications Commission (FCC) standards. **10**


**Industry Canada Mark**
In Canada, any product that connects to the public telephone network (PTN) must have Industry Canada approval and carry this mark. The version with the Canadian flag was used until January 1, 2003. The simplified version is used after January 11, 2003. **11**

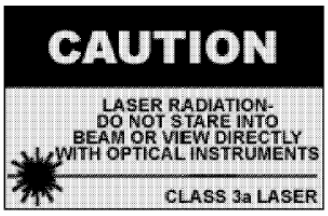

**Class 1 Laser Mark**

Explanatory label bearing the words:

LASER RADIATION
DO NOT STARE INTO BEAM
CLASS 1 LASER PRODUCT **12**

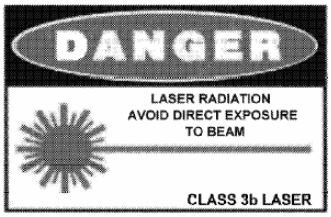

**Class 2 Laser Mark**

Warning sign for Class 2 lasers. **12**



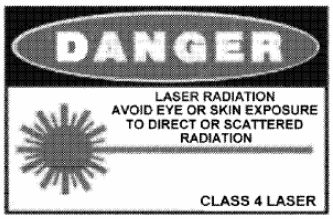

**Class 3a Low Irradiance Laser Mark**

Warning sign for Class 3a low irradiance lasers. **12**




**Class 3b Laser Mark**

Warning sign for Class 3b lasers. **12**




**Class 4 Laser Mark**

Warning sign for Class 4 lasers. **12**

This is the hazardous chemical label for Canada's Workplace Hazardous Materials Information System (WHMIS).


1. **Product Identifier**
2. **Hazard Symbol**
3. **Risk Phrases**
4. **Precautionary Measures**
5. **First Aid Measures**
6. **Statement of Availability of MSDS**
7. **Supplier Identifier**

**Workplace Hazardous Materials Information System (WHMIS) 13**

# Appendix B. Canada Information

This appendix provides safety instructions for service representatives in Canada. The information in this appendix is *mandatory* reading for Canadian service representatives.

## Workplace Hazardous Materials Information System (WHMIS)

Canada's "Right-to-know" legislation is called Workplace Hazardous Materials Information System (WHMIS). In French, WHMIS is called SIMDUT, Système d'Information sur les Matières Dangereuses Utilisées au Travail. Each of the thirteen provincial territorial and federal agencies responsible for occupational safety and health have established WHMIS requirements within their respective jurisdiction.

Its purpose is to ensure that all hazardous materials in the workplace are identified and that workers know the hazards and the proper procedures to avoid being harmed by them.

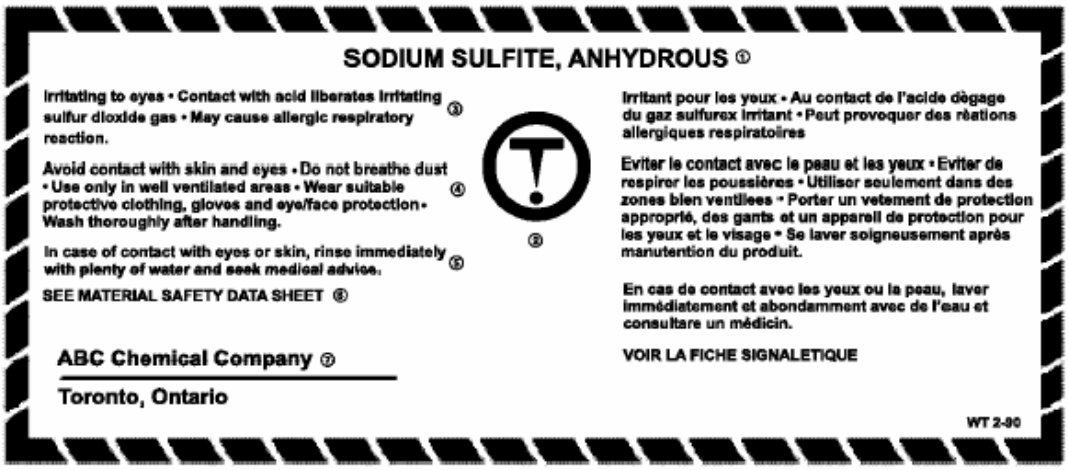
WHMIS consists of three parts:

- Labels
- Material Safety Data Sheets (MSDSs)
- Employee education

Although these elements are similar to the United States hazard communication system, there are distinct differences between the two. Chemical labels that meet requirements in the United States do not meet WHMIS requirements.

### WHMIS Supplier List

A WHMIS supplier label can be identified by its unique hatched border and circular hazard symbols




1. Product Identifier
2. Hazard Symbol
3. Risk Phrases
4. Precautionary Measures
5. First Aid Measures
6. Statement of Availability of MSDS
7. Supplier Identifier

The WHMIS supplier label includes the:

- Product name
- Supplier identifier – the company that sold it
- WHMIS hazard symbol(s) – pictures for the WHMIS classes shown below
- WHMIS hatched border
- Reference to the availability of a Material Safety Data Sheet (MSDS)
- Risk phrases – words that describe the main hazards of the product
- Precautions – how to work with the product safety
- First aid instructions

WHMIS supplier labels must be in English and French.

## WHMIS Classes

WHMIS-controlled products are classified under one or more of the following classes of hazards.

### CLASS A: Compressed Gas

Material contained under pressure. Dry chemical fire extinguishers and pressurized cylinders of acetylene, oxygen, or nitrogen are examples of compressed gases.

### CLASS B: Flammable and Combustible Materials

Material that readily ignites or burns or may react with water to produce a flammable gas and has a flash point of less than 93.3 degrees C. An example is isopropyl alcohol.

### CLASS C: Oxidizing Materials

A peroxide or a substance that will cause another substance to burn by supplying oxygen. Examples are hydrogen peroxide and oxygen. Oxidizers must not be stored with flammable materials.

### CLASS D1: Materials Causing Immediate and Serious Toxic Effects

Material that causes harmful effects and possible death within a short period of time after exposure. Poisonous. Examples are isocyanates, trichloroethane, turpentine, and carbon monoxide.

### CLASS D2: Materials Causing Other Toxic Effects

Material that cause harmful effects days, months, or years after one or more exposures. Material that can cause cancer, birth defects, or sterility are included in this class. Examples are lead, toluene, and isopropyl alcohol.

**CLASS D3: Biohazardous Infectious Materials**
An organism or its toxins that may cause serious infectious disease. An example is contaminated blood.

**CLASS E: Corrosive Material**
A substance that can attack and destroy human tissue and other materials on contact. Examples are acids and sodium hydroxide (caustic soda).

**CLASS F: Dangerously Reactive Materials**
Material that will react with water to produce a poisonous gas, or that will undergo a reaction under conditions of shock or an increase in pressure or temperature. Examples are nitromethane, styrene, and vinyl chloride.

A Material Safety Data Sheet (MSDS) must be readily available for all WHMIS-controlled products and must not be more than 3 years old. An MSDS provides more detailed hazard information about the product.

The MSDS should be shipped with any chemical destined for a customer location. The MSDS can be accessed at:

http://w3-1.ibm.com/chq/chemical

Select "Search for IBM Service Chemicals or Product Supplies" on the left hand navigator panel. Then on the search panel fill in the chemical/product name or number and select "Canada" in the country window.

Before working with any hazardous material you should:

- Read the label
- Read the MSDS
- Understand the hazards and how to protect yourself

WHMIS applies to hazardous materials only. Therefore, not all chemicals used by IBM service personnel are regulated by WHMIS or subject to the stringent WHMIS labeling and MSDS requirements.

WHMIS training is required by law for anyone working with, or in close proximity to, WHMIS-controlled products in Canada. Consult your manager for specific training related to your job.

## PCB Handling Instructions

You must not under any circumstances accept for disposal by IBM any PCB material or PCB-contaminated material that was removed from equipment that is owned by a customer. A kit for packaging PCB capacitors is available from your local branch office or from the Toronto Parts Distribution Centre. Handling instructions are in the kits or online in the Lotus Notes Integrated Technology Services Information Library under the business process "Safety." Do not ship PCB material until you receive further instructions from the Environmental Coordinator at headquarters.

## Battery Disposal Instructions

Spent batteries that are removed during customer hardware maintenance activities are to be returned through the used parts return (UPR) process, regardless of whether or not they are flagged UPR or CAN UPR.

Ensure that batteries are packaged in a strong container (in original battery packaging and box, if possible) separate from other UPR parts. Tape the battery terminals to protect from short circuiting and subsequent fire. Different battery types and chemistries, such as lead acid, nickel cadmium, or lithium, should *not* be packaged together.

Do *not* ship batteries by air.

Nickel cadmium (NiCd), nickel metal hydride (NiMH) and lithium (Li or Li+) batteries are not Transportation of Dangerous Goods (TDG) regulated.

Lead –acid (Pb acid) batteries, including Uninterruptible Power Supplies (UPS), may be fully regulated under the Transportation of Dangerous Goods, and may require proper classification, marking, and documentation, which must be completed by TDG-certified personnel.

Lead acid batteries and UPS's must be upright during shipping. Ensure that the UPS switch is deactivated, wherever possible, prior to shipping.

Refer to the IBM Canada TDG Manual for shipping information at:

http://w3.can.ibm.com/services/its/can/safety/index.html

IBM Canada's TDG representative should be consulted for shipping information about any battery types and chemistries not listed above or for further clarification.

### Service Representatives Transporting Chemicals

The transportation of hazardous materials is regulated. Some examples of regulated hazardous materials that are commonly carried by service representatives include isopropanol and aerosols to name a few.

A current list of regulated materials can be obtained from your business unit's chemical coordinator or they can be identified as follows:

- HAZARDOUS written at top right-hand section of Automated Parts Order Form (APOF)
- "H" in HAZARDOUS DANGER column on right-hand side of APOF
- "H" below HAZ on real Time System
- "Y" beside US HZD or CAN HAZ on Parts Inventory Management System (PIMS)

### Transporting Hazardous Materials by Air

Service representatives are not to ship chemicals on airplanes without approval from your business unit's chemical coordinator or from the Transportation of Dangerous Goods (TDG) representative, both of whom reside at headquarters in Markham, Ontario. Local purchases of chemicals must also be approved by your business unit's chemical coordinator due to health and safety considerations, compliance to regulations, and to ensure compatibility with equipment.

#### Transporting Hazardous Materials by Road

When transporting materials that are Transportation of Dangerous Goods-regulated materials by road,

Canadian service representatives must label any packaging containing TDG-regulated materials as “Limited Quantity”, “LTD QTY”, or “Consumer Commodity”. The “Limited Quantity” or “Consumer Commodity” marking must be visible, legible, marked on at least one side other than the side on which it is intended to rest or to be slacked during transport. The gross mass of the package (i.e. packaging + contents) can not exceed 30 kg. The packaging must be designed in such a way as to prevent an accidental release of the dangerous goods during transport.

Canadian service representative will need to do the following to comply with the TDG regulation, if they are carrying any materials regulated for transportation:

1. Label their tool bags with “LTD QTY” or “Consumer Commodity”, “LTD QTY” labels are available from your local stock room under IBM P/N 29P4474. It is recommended that all sides be labeled so that it does not matter how the bag is placed in the vehicle, the “LTD QTY” will always be visible. The tool bag must not exceed 30 kg as specified in the regulation ; OR

2. Use a luggage tag marked with “Limited Quantity”, “LTD QTY” or “Consumer Commodity” that is visible and legible, and that is marked on both sides of the tag; OR

3. Carry any TDG-regulated materials in a box labeled “LTD QTY” or “Consumer Commodity” during transport. Again, each box must not exceed 30 kg and you must ensure that “LTD QTY” is visible and not hidden by stacking boxes over the label.

It is not advisable to label an individual bottle containing TDG-regulated material with “LTD QTY” or “Consumer Commodity” because the label can not cover any hazard information on the bottle. Also, the “LTD QTY” label must also be on the outer packaging, which would not be visible inside a tool bag.

“LTD QTY” labels must be removed from the outer packaging when the package is used for purposes other than carrying TDG-regulated goods.

Failure to comply with this regulated could subject IBM Canada to citations and significant fines.

# Appendix C. United States Information

This appendix provides safety instructions for service representatives in the United States.

## PCB Handling Instructions

The following procedures explain how to dispose of capacitors from the field location.

- Put the Environmental Protection Agency PCB label on all shipments. The label is available from Mechanicsburg Publications.
- Prepare the bill of lading or United Parcel Service manifest for each PCB parts shipment. The bill of lading should state the number of return items and a list of the part numbers not required.
- Keep a copy of the bill of lading on file indefinitely. This is an audit requirement, and the government has not specified how long to maintain a copy of the bill of lading.
- Send the shipment through the recycle program to the IBM Endicott location. Use the UPR MB plant address.

## Battery Disposal Instructions

You can store batteries in cardboard boxes; however, each box must not exceed 10 pounds. To control the movement of used batteries, all batteries that you return without the used parts return (UPR) code are shipped to the following address:

IBM Corporation
Battery Return Program, Dept 713
3605 Hwy 52N
Rochester, MN 55901-9907

You should comply with the used parts return (UPR) code to return batteries. You should ship the batteries prepaid. Use the least expensive surface mode of transportation, which is identified by the Shipping Management System (SMS) or the Transportation Routing Information Pricing System (TRIPS).

You must not ship, under any circumstances, batteries by air or United Parcel Service (UPS) with an airway bill of lading.

You must not ship batteries that are regulated by the Department of Transportation (DOT) as hazardous materials without the proper classification, marking, labeling, and documentation. A trained and certified employee must complete the classification, marking, labeling, and documentation.

The Department of Transportation regulates batteries that contain sodium, dry batteries that contain potassium hydroxide, wet batteries that contain acid or alkali, non-spillable batteries, and lithium batteries. If you are unsure what type of battery you are returning, contact your local chemical coordinator.

### How to Access a Material Safety Data Sheet (MSDS)

You can find Field Use Material MSDS's at:

http://w3-1.ibm.com/chq/chemical/

## Materials of Trade for Service Representatives

You are exempt from certain dangerous goods transportation regulations if you comply with the "Materials of Trade" requirements. U.S. Department of Transportation regulations define materials of trade as "hazardous materials other than hazardous waste, that are carried by a private motor carrier in direct support of a principal business that is other than transportation by motor vehicle." When transportation is by a private motor vehicle, materials of trade are exempt from hazardous material (hazmat) regulations if there are less than 30 kg (66 pounds) or 30 L (8 gallons) of a flammable liquid, corrosive, flammable solid, or oxidizer in a single package.

Note : Service representatives who transport Materials of Trade must be aware that they are complying with the "Materials of Trade" requirements in 49 CFR (Code of Federal Regulations) Department of Transportation, Hazardous Materials Regulations.

In addition, containers must be leak-tight for liquids and gases and sift-proof for solids. You must close the containers, secure them against movement, and protect them from damage. You must pack the containers in the manufacturer's original package or a package of equal or greater strength and integrity. Outer packaging is not required for some items, such as cans and bottles, if they are secured against movement in boxes, bins, or similar containers. You must mark each package with a common name like paint or a proper shipping name like "Aerosol-flammable" to identify the material it contains. You must inform the motor vehicle operator that the vehicle contains a material of trade and provide packaging information.

### Additional Information on Transportation of Dangerous Goods

It is very important to understand that you must not ship hazardous/dangerous materials unless you have been certified and are maintaining your certification to ship hazardous materials. When traveling on an airplane, do not transport hazardous materials in your carry-on or checked luggage.

Examples of hazardous materials, or dangerous goods, include:

- Isopropyl alcohol
- Aerosols (ex: aerosol paints)
- Cleaning solvents (ex: toner cleaner and fuser oil remover)
- Magnetized materials that are shipped by air
- Radioactive materials
- Articles pressurized pneumatically (gas springs)
- Some types of batteries (ex: ones that can spill)

This list is not all-inclusive. If you have ANY questions about whether a material is regulated in transportation, contact your local chemical coordinator.

Approved Chemical Field Use Materials

The chemical field use materials (FUMs) used within IBM must be approved by an IBM Chemical Coordinator. ITS Environmental Affairs maintains a list of chemical FUMs approved for use by ITS employees in the United States. This list may be accessed by going to the ITS EA department website at http://as1.lexington.ibm.com/safety/ and selecting "Approved Chemicals." The chemicals on this list should be used as stated in the appropriate maintenance manuals. If you wish to become a new user of any of these chemicals, a short review may be necessary. Please note that there may be special situations where approvals maybe given for chemicals that do not appear on the list. If you are an ITS employee, please contact the ITS US Chemical Coordinator for more information. Otherwise, contact your local chemical coordinator for information on approved chemicals.

## California Work Locations Only: Proposition 65 Information

Proposition 65 (the Safe Drinking Water and Toxic Enforcement Act of 1986) requires the state to identify and list chemicals that can cause cancer (carcinogens) or adverse reproductive effects (such as birth defects) in laboratory animals or humans. It also requires businesses of 10 or more employees (other than local state or federal government agencies) to warn of possible exposure to those chemicals before any exposure occurs. Since IBM uses some chemicals on the state's list, we are providing the following information. If you require additional information, contact one of the organizations listed at the end of this appendix.

The Proposition 65 Governor's List is found at:

http://www.oehha.org/prop65/prop65_list/Newlist.html

The "Safe Drinking Water and Toxics Enforcement Act of 1986," (California Health & Safety Code, Section 25249.6), states: "No person in the course of doing business shall knowingly and intentionally expose any individual to a chemical known to the state to cause cancer or reproductive toxicity without first giving clear and reasonable warning to such individual."

**Occupational Exposure Warnings**. When warnings are required for occupational (workplace) exposures at IBM facilities, they are provided through the site Employee Hazard Communication Program, including "Right-to-Know" training, Chemical Hazard Profiles and Material Safety Data Sheets.

Every IBM facility in California is required to post a Proposition 65 notice on the building legal bulletin board. We also use Proposition 65 warning signs to identify specific pieces of equipment or areas where people may have access or exposure to Proposition 65 chemicals.

Non-IBM facilities in California **are also required to post Proposition 65 notices**. Contact the building owner if the notice cannot be located.

**Environmental Exposure Warnings**. The following are examples of warnings that IBM provides for environmental exposures on IBM premises. These may be applicable in facilities at which you work or visit.

WARNING: Smoke from barbecuing contains chemicals known to the State of California to cause cancer.

WARNING: Small amounts of lead may be present intermittently in the water from drinking water fountains, coolers and beverage dispensers, but at levels which meet or are better than safe drinking water standards. Lead is known to the State of California to cause birth defects or other reproductive harm.

WARNING: Materials containing fiberglass wool are present in some ceiling spaces, modular walls and ventilation systems. These may intermittently add detectable amounts of glass wool fibers to the building air, at levels which meet or are better than applicable exposure standards. Glass wool fibers of respirable size are known to the State of California to cause cancer.

WARNING: Intermittent diesel exhaust may be present in facilities at which you visit or work, from trucks, forklifts, generators or boilers. Diesel engine exhaust is known to the State of California to cause cancer.

WARNING: Ceiling tiles and similar materials in our buildings may contain palygorskite, also known as attapulgite. Palygorskite fibers are known to the State of California to cause cancer.

**Environmental / Occupational Exposure Warning**.

WARNING: The wires, cables and/or cords of electrical devices like computers, telephones and peripherals commonly use polyvinyl chloride (PVC) insulation. Cords and cables using PVC insulation contain lead and other chemicals known to the State of California to cause cancer, and birth defects or other reproductive harm. ***Wash hands after handling***.

# Appendix D. Health Effects of Chemicals

This appendix provides information about the health effects of chemicals on the human body.

## Routes of Entry into the Body

**Absorption.** The skin is a protective barrier that helps keep foreign chemicals out of the body. However, some chemicals can easily pass through intact skin and enter the bloodstream. If the skin is cut or cracked, chemicals can penetrate through the skin more easily. Also, some caustic substances, like strong acids and alkalis, can chemically burn the skin. Others can irritate the skin. Many solvents dissolve the oils in the skin, leaving it dry, cracked, and susceptible to infection and absorption of chemicals.

The skin can be protected by the use of impermeable gloves, available through your parts distribution center or local safety supply store.

Some chemicals can burn or irritate the eyes as well. Occasionally, they can be absorbed through the eye and enter the bloodstream. The eyes are easily harmed by chemicals, so precautions should be taken to avoid contact by using chemical goggles or safety glasses with side shields.

Employees who wear contact lenses must be especially cautious. Contact lenses must not be worn in areas where there is a recurring overexposure to a substance above the permissible exposure limit (PEL), threshold limit value (TLV), or permissible exposure value (PEV), or where significant concentrations of chemical, particulate, or other airborne contaminants are normally present. Employees who wear contact lenses should wear chemical goggles or safety glasses with side shields. They should also have a spare pair of glasses readily available. Spare contact lenses are optional.

**Inhalation.** The principal route of entry into the body is through inhalation. Chemicals may be present in the air as vapor, particulate or mist. Some chemicals are irritants and cause nose or throat irritation. They can also cause discomfort, coughing, or chest pain when they are inhaled. Other chemicals can be inhaled without causing such warning symptoms, but they still can be dangerous.

Sometimes a chemical is present in the air in the form of dust or mist. The body's defense mechanisms trap some particles. Many particles may be coughed out. Others, depending on their size, can stay in the lungs and can cause lung damage. Some particles can dissolve and be absorbed into the blood stream and have effects elsewhere in the body. The mere presence of dust in a work environment does not, of itself, create a hazardous situation. The chemical composition of the dust, its particle size, and its concentration in the air are important factors in evaluating the degree of hazard associated with any exposure to dusts.

To minimize your exposure to chemicals, ensure that the area you are working in has adequate ventilation. In cases where ventilation is inadequate, personal protective equipment (PPE), such as a respirator, might be necessary.

Refer to the "Personal Protective Equipment" lesson in Module 5 for more information about PPE.

**Ingestion.** You can ingest small amounts of material by eating, drinking, or smoking when your hands have been exposed to chemicals in the workplace. The amount you accidentally swallow is small but could potentially cause toxic effects if the chemical is toxic enough. If you work with chemicals, wash our hands before eating or smoking.

## Acute versus Chronic Exposures

The effects of toxic substances may appear immediately or soon after exposure, or they may take many years to appear. Acute exposure is a single exposure or a few exposures. Acute effects are those that occur following acute exposures. Acute effects can occur immediately, or be delayed and occur days or weeks after exposure. Chronic exposure is exposure that occurs over months and years. Chronic effects are those which occur following chronic exposures and so are always delayed.

A toxic chemical can cause acute effects, chronic effects, or both. For example, if you inhale solvents on the job, you might experience acute effects, such as headache and dizziness, that go away at the end of the day. Over months, you might begin to develop chronic effects, such as liver and kidney damage.

The delay between the beginning of exposure and the appearance of disease caused by that exposure is called the latency period. Some chronic effects caused by chemicals, such as cancer, have very long latency periods. Cancer has been known to develop as long as 40 years after a worker's first exposure to a cancer-causing chemical.

The length of the latency period for chronic effects makes it difficult to establish the cause-and-effect between the exposure and the illness. Because chronic diseases develop gradually, you can have the disease for some time before it is detected. It is important for you and your physician to know what chronic effects might be caused by the substances you use on the job.

## LC50 and LD50

The LC50s and LD50s are sometimes found on Material Safety Data Sheets (MSDS). They are indicators of acute toxicity only, not of chronic effects, for non-human mammals.

**LC50.** The concentration of a material in air that, on the basis of laboratory tests, is expected to kill 50% of a group of test animals when inhaled as a single exposure (usually in one to four hours).

**LD50.** The dose of a substance that causes the death of 50% of an animal population from exposure to the substance by any route other than inhalation when given all in one dose. LD50 is usually expressed as milligrams or grams of material per kilogram of animal weight (mg/kg or g/kg, where 50 g equal 1 teaspoonful).

LC50 and LD50 must be interpreted carefully in relation to the likelihood of human acute health effects and must never be considered an indicator of the likelihood of chronic effects. The following chart attempts to correlate LC50s and LD50s to human acute effects.

Table E-1. *Correlation of LC50s to LD50s*

| Descriptive Term | LD50 mg/kg (Oral) | LD50 mg/kg (Skin) | Gas (ppm) | LC50 4-hour inhalation Vapor (ppm) | LC50 4-hour inhalation Dust (mg/m$^3$) |
|---|---|---|---|---|---|
| Very toxic | Below 50 | Below 200 | Below 2500 | Below 1500 | Below 0.5 |
| Toxic | 50-500 | 200-1000 | 2500 | 1500-2500 | 0.5-2.5 |
| Essentially nontoxic | Above 500 | Above 1000 | Above 2500 | Above 2500 | Above 2.5 |

Categories, such as carcinogen, mutagen, reproductive toxin, and teratogens, can appear on an MSDS and are examples of substances that cause chronic effects. An explanation of each category follows.

## Carcinogens

Not all chemicals cause cancer. In fact, most substances do not cause cancer, no matter how high the dose. Only a relatively small number of the many thousands of chemicals in use today cause cancer.

Chemicals that can cause cancer are called carcinogens, and the ability to cause cancer is called carcinogenicity. Evidence for carcinogenicity comes from either human or animal studies. There is enough evidence for about 30 chemicals to be called carcinogenic in humans. About 200 other chemicals are known to cause cancer in laboratory animals and are, therefore, considered possibly carcinogenic to humans.

Determining the causes of cancer in humans is difficult. There is usually a long latency period (10 to 40 years) between the start of exposure to a carcinogen and the appearance of cancer. A substance must be used for many years before enough people are exposed to it long enough for researchers to see a pattern of increased cancer cases. It is often difficult to determine whether an increase in cancer in humans is due to exposure to a particular substance, because exposure might have occurred many years before and people are exposed to many different substances.

Because the study of cancer in humans is difficult and requires that people be exposed to carcinogenic chemicals and possibly develop cancer, chemicals are tested for carcinogenicity by external agencies that use laboratory animals. If animals were exposed to the low levels typical of most human exposure, many hundreds of animals would be required for only a few to develop cancer. To avoid this, animal cancer tests use large doses of chemicals to detect an increase in cancer in a reasonable number of animals, such as 25 to 50. However, animal tests are still expensive, take about three years to perform, and are often inconclusive. When an animal cancer test is positive, the risk to a small number of rats at high doses must be used to try to predict the risk to humans at much lower doses. Chemicals that cause cancer in animals are considered possible carcinogens in humans, even though the degree of risk is uncertain.

The issue of whether there is a safe dose for a carcinogen is controversial. Some scientists believe that any exposure, no matter how small, carries some risk. However, at very low exposures, the risk, if any, may be so small that it can be considered the same as no risk at all. Most carcinogens appear to require either exposure over a number of years or very high doses before the risk of developing cancer becomes a serious concern.

### Mutagens

Toxic chemicals can also cause genetic damage. The genetic material of a body cell consists of genes, which exist in chromosomes. Genes and chromosomes contain the information that tells the cell how to function and how to reproduce (form new cells).

Some chemicals can change or damage the genes or chromosomes. This kind of change, or damage in a cell, is called a mutation. Anything that causes a mutation is called a mutagen. Mutations can affect the way the cell functions or reproduces. The mutations can also be passed on to new cells that are formed from the damaged cell. This can lead to groups of cells that do not function or reproduce like the original cell before the mutation occurred.

Some kinds of mutation result in cancer. Most chemicals that cause cancer also cause mutations. However, not all chemicals that cause mutations cause cancer.

Tests for the ability of a chemical to cause a mutation take little time and are relatively easy to perform. If

tests show a chemical to be a mutagen, additional tests must be performed to prove the chemical also causes cancer.

### Reproductive Toxins

Any agent that has a harmful effect on the adult male or female reproductive system or the developing fetus or child is a reproductive toxin. Such hazards affect people in several ways, including inability to conceive children (infertility or sterility), lowered sex drive, menstrual disturbances, spontaneous abortions (miscarriages), stillbirths, and defects in children that are apparent at birth or later in the child's development.

**Teratogens and fetotoxins.** Teratogens are reproductive toxins that cause physical or mental defects in a developing fetus as a result of exposure of the pregnant female to a chemical at a concentration that has no adverse effect on the expectant mother. Chemicals that harm the fetus are called fetotoxins. At the embryonic stage of development of the fetus from two to eight weeks, the fetus is particularly at risk of injury from such chemicals. If a chemical causes health problems in the pregnant woman herself, the fetus may also be affected. Thalidomide, an anti-nausea drug prescribed to pregnant women in the late 50s and early 60s, is an example of a teratogen that caused severe malformations (shortening or complete absence of limbs) in infants without causing adverse effects to the mother.

There is not enough information about the reproductive toxicity of most chemicals. Most chemicals have not been tested for reproductive effects in animals. It is difficult to predict risk in humans with animal data. There could be safe levels of exposure to chemicals that affect the reproductive system. However, trying to determine a *safe* level is very difficult, if not impossible. It is even more difficult to study reproductive effects in humans than it is to study cancer. At this time, only a few industrial chemicals are known to cause birth defects or other reproductive effects in humans.

## Exposure Limits

Threshold Limit Values (TLVs) are exposure guidelines that the American Conference of Governmental Industrial Hygienists (ACGIH) (an independent professional organization of industrial hygienists) has established for airborne concentrations of many chemical compounds. The threshold limit is the lowest airborne concentration at which it is believed that nearly all workers could be repeatedly exposed day after day without adverse health effects.

The TLV is different from chemical to chemical. Although the threshold for one chemical can differ from person to person, in general, if the concentration of a chemical in the air is kept well below the threshold level, harmful effects probably will not occur. Levels above the threshold indicate there is a possibility that health effects might occur, not that such effects definitely will occur. The data for establishing TLVs comes from animal studies, human studies, and industrial experience. The limit can be selected for several reasons. For example, the TLV can be determined for a substance that is very irritating to the majority of people exposed, or other substances that might be asphyxiants, anesthetics, or allergens.

Threshold Limit Values cannot always be completely protective for the following reasons:

- Exposure limits are set to protect most workers; however, because individual susceptibility varies widely, there might be a few workers who will be affected by a chemical at levels below these limits.
- Exposure values are based on average working conditions. Employees performing extremely heavy physical exertion breathe in more air and more of a chemical and so can absorb an excessive amount.
- Exposure limits are set for individual chemicals and not for mixtures. As a result, the TLV of mixtures must often be estimated. When two or more chemicals have the same health effects, the exposure limits of each ingredient of the mixture are additive (1 + 1 =2). This applies to chemicals that have additive effects, but not to those that are synergistic or potentiating. Refer to the topic about “Reaction and Interactions of Chemicals” in the “Chemical and Health Effects” lesson in Module 4 of this

workbook.

- Exposure limits usually apply to the concentration of a chemical in the air and are established to limit exposure by inhalation. Limiting the concentration in air might not prevent excessive exposure through skin contact or ingestion.

ACGIH has established three types of exposure limits:

- The 8-hour time weighted average (TWA) is the average employee exposure over an 8-hour period and 40-hour work week to which it is believed nearly all workers can be repeatedly exposed without adverse health effects. The level can sometimes go above the TWA value, as long as the 8-hour average stays below. All chemicals with TLVs have a TWA. Only a few chemicals have ceiling and excursion limits.
- The ceiling limit is the maximum allowable level. It must never be exceeded.
- The short-term exposure limit (STEL) is the concentration to which it is believed workers can be exposed continuously for a short period of time, usually between 5 to 15 minutes, without suffering adverse health effects (providing the daily TWA is not exceeded).

ACGIH exposure limits can differ from your country's exposure limits. Refer to the MSDS for your country's exposure values or consult your local chemical coordinator. Threshold limit values are reviewed and updated each year as new information becomes available.

IBM also establishes a permissible exposure value (PEV) for some substances. The IBM PEV is the version of the time weighted average (TWA) that IBM established. The action level set by IBM is 25% of the current TLV, IBM PEV, or applicable government regulation, whichever is lower. The IBM action level is not a threshold for adverse health effects. As applied to a TLV, PEV, or government-established value, it is a trigger for investigation to prevent exposures from exceeding the eight-hour TWA. It is not a limit.

# Appendix E. Other Resources

This appendix lists sources of additional information about health and safety.

- *General Safety for IBM Service Representatives* handbook, available via soft copy only at: http://trgweb.atlanta.ibm.com/courses/SAFETY/gensafe.pdf

- *Electrical Safety for IBM Service Representatives* handbook, available via soft copy only at: http://trgweb.atlanta.ibm.com/courses/SAFETY/elecsafe.pdf

- *IBM Global Well-being Manual* at: http://w3-1.ibm.com/hr/us/ohs/gohsweb.nsf/pages/references.htm

- *IBM Healthy Computing web site at*: http://www.pc.ibm.com/us/healthycomputing/

- IBM Ergonomics web site at: http://w3-1.ibm.com/hr/us/ohs/gohsweb.nsf/pages/ergonomics.htm

- IBM Ergonomics Training web site at: http://w3-1.ibm.com/hr/us/ohs/gohsweb.nsf/pages/ergotrain.htm

- Ergonomics Training Videos on CD-ROM (order via the IBM Publications Center at: http://ibm.com/shop/publications/order or in Canada through IBMPUBS on VM)
  - "Ergonomics for Remote & Mobile Workers," Part No. GK3T-3533-00
  - "Prevention of Back Injuries," Part No. GK3T-3533-00

- IBM Employee Well-being (including IBM Global Occupational Health Services) web site at: http://w3-1.ibm.com/hr/us/ohs

- *IBM North American Field Operations Well-being Guide:* http://9.9.182.15/courses/SAFETY/NAFOWbG_1.pdf

- IBM Corporate Product Safety Web Page http://w3-1.ibm.com/chq/environment/ps/index.htm

- Your service manuals and references for the equipment you maintain. Follow all safety instructions contained in these documents.

# Glossary

This glossary provides definitions of terms that are used in the course.

**acetone**. A volatile, fragrant, flammable, liquid ketone used mainly as a solvent.
**acute**. Having a sudden onset, sharp rise, and short course; lasting a short time.
**alkaline**. Having a pH of more than 7. See *pH*.
**allergen**. A substance that induces a reaction, such as sneezing, respiratory problems, itching, or skin rash.
**alternating current (ac)**. Electric current that reverses direction in a circuit at regular intervals.
**ampere (amp)**. A unit of electrical measurement that indicates the rate of flow of electrons, or electrical current. One ampere is equal to 6.25 x 10 electrons per second.
**amputation**. Removing a finger, arm, leg or other part of the body surgically or by other mechanical action.
**arsenide**. A binary component of arsenic with a more positive element.
**asbestos**. The generic term for hydrated mineral silicates that separate into flexible fibers when they are crushed. The use of asbestos is limited because it is linked to lung cancer in humans
**asphyxia**. Unconsciousness or death caused by lack of oxygen.
**Asphyxiant**. A substance that causes unconsciousness or death by depriving the body of oxygen.
**atom**. The smallest unit of matter, consisting of a positively charged nucleus surrounded by a system of electrons equal in number to the number of nuclear protons.
**audiometric**. A term that describes the measurement for the acuity (sharpness) of hearing.
**biphenyl**. A white crystalline hydrocarbon used especially as a heat transfer medium.
**capacitance**. The property of an electric nonconductor that permits the storage of energy as a result of the separation of charge that occurs when opposite surfaces of the nonconductor are maintained at a difference of potential.
**capacitor**. A device that provides capacitance and usually consists of conducting plates or foils separated by thin layers of dielectric (as air or mica) with the plates on opposite sides of the dielectric layers oppositely charged by a source of voltage and the electrical energy of the charged system stored in the polarized dielectric.
**carbon black**. Pigment in paint, plastics, inks, toners, and other products that possibly causes cancer in humans.
**carcinogen**. A substance or agent that produces cancer.
**cardiopulmonary resuscitation (CPR)**. A procedure marked by the rhythmic compression of the chest to restore proper circulation and respiration.
**certification mark**. A mark or device that identifies a product or service that has been certified to conform to a particular set of standards.
**chlorofluorocarbon**. Simple gaseous compound containing carbon, chlorine, and fluorine that may be used as a refrigerant, cleaning solvent, aerosol propellant, or plastic foam. Using chlorofluorocarbons is prohibited because they are linked to ozone depletion.
**chronic**. Marked by long duration or frequent recurrence; not acute.
**circuit**. A system of electrical components forming a closed path that allows electrical current to flow.
**circuit breaker**. An automatic switch that stops the flow of electric current in a suddenly overloaded or otherwise abnormally stressed electric circuit.
**cochlea**. A spiral tube of the inner ear containing nerve endings that transmit sound impressions to the brain.
**conductor**. A material with many free electrons and, therefore, having little resistance to the flow of electricity.
**contraction**. A shortening of a muscle.
**combustible**. Any substance capable of catching fire and burning.

**corrosive**. A chemical that can burn skin and eyes.
**CPR**. See *cardiopulmonary resuscitation*.
**cryogenic**. Materials that are very cold, like liquefied oxygen, nitrogen at approximately -260°C.
**current**. The flow of negatively charged particles called electrons through a conductor. The symbol for current is I.
**decibel**. The most common unit used to measure the loudness of a sound.
**dermatitis**. A skin rash, inflammation of the skin.
**detoxify**. To remove, break down, or otherwise render harmless a poison or toxic substance.
**direct current (dc)**. An electric current flowing in one direction.
**docking station**. A platform into which you can install a portable computer. The docking station typically contains expansion cards, bays for storage devices, and connectors to peripheral devices, such as printers and monitors.
**ear canal**. The short tube conducting sound from the outer ear to the eardrum or tympanic membrane.
**eardrum**. A thin membrane stretched across the inner opening of the ear canal. Its vibrations are passed to the bones of the inner ear.
**egress**. A place or means exiting a building, an exit.
**electricity**. The energy released by the flow of electrons.
**electrons**. Negatively charged subatomic particles that orbit the nucleus of an atom.
**electrostatic field**. The force field that surrounds any charged object. Atoms are held together by the electrostatic field between electrons and protons.
**EPO**. Emergency power off.
**ergonomics**. The applied science that studies the design and arrangement of things that people use so people and things interact more efficiently and safely.
**fault**. A defect in a circuit or wiring caused by imperfect connections, poor insulation, grounding, or shorting.
**fetotoxins**. Chemicals that harm a fetus but not the mother. See *teratogens*.
**flammable**. Having a flash point less than 100 degrees F; capable of igniting easily and burning quickly.
**flash point**. The lowest room temperature at which a volatile liquid gives off enough vapor to produce a flame when a source of ignition is placed near its surface.
**FM200®**. A synthetic compound designed to replace halon fire extinguishing agents. FM200® does not damage the ozone layer but does contribute to global warming.
**freezing current**. Electric current of 5 to 25 mA. A victim of this level of current remains motionless while in contact with the source.
**frequency**. The number of sound waves (compression and expansion) per second. Frequency determines how deep or shrill the sound seems.
**frequent business driver**. An IBM employee who is required by management to have an automobile available for work on a continuing basis on each work day to discharge his or her primary job responsibilities.
**frying current**. Electric current of 200 mA or greater. This current level is capable of cooking the skin and tissue of its victim.
**global warming**. An increase in the near surface temperature of the earth. Global warming has occurred in the distant past as the result of natural influences, but the term is most often used to refer to the warming predicted to occur as a result of increased emissions of greenhouse gases.
**greenhouse gas**. Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide, methane, nitrous oxide, halogenated fluorocarbons (HCFCs), ozone, perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs).
**ground (earth)**. A large conducting body, such as the earth, used as a return for electric currents and as an arbitrary zero of potential; the position or portion of an electric circuit that is at zero potential with respect to the earth; a conducting connection to such a position or to the earth.
**grounded (earthed) conductor**. The return path for current flow in a single-phase circuit, also known as the neutral conductor.
**grounding (earthing) conductor**. A normally non-current-carrying safety ground that provides a path to

ground (earth) for electric current to protect personnel and equipment when fault conditions occur; also known as the green wire safety ground.
**Halon**. A fire extinguishing agent that interferes with the combustion process by inhibiting the flame chain reaction; halon is similar to chlorofluorocarbons that damage the earth's ozone layer.
**hazard**. The likelihood that a substance will cause injury in a given situation.
**impedance**. The combined effect of resistance, inductance, and capacitance on a signal at a given frequency.
**industrial hygiene**. A profession dedicated to the anticipation, recognition, evaluation, and control of occupational health hazards.
**Inergen®**. The trademark for a blend of nitrogen, argon, and carbon dioxide that reduces the oxygen concentration below 16% to suppress fires.
**insulator**. A material that has few free electrons and, therefore, resists the flow of electricity.
**intranet**. A private, corporate computer network that connects departments or divisions within a corporation.
**ketone**. A class of organic compounds containing the CO group. Acetone is an example of a ketone.
**knockout current**. Electric current of between 25 and 100 mA that causes victims to lose consciousness.
**LC50**. The concentration of a material in air that, on the basis of laboratory tests, is expected to kill 50% of a group of test animals when inhaled as a single exposure (usually one to four hours).
**LD50**. The dose of a substance that causes the death of 50% of an animal population from exposure to the substance by any route other than inhalation when given all in one dose. LD50 is usually expressed as milligrams or grams of material per kilogram of animal weight (mg/kg or g/kg, where 50 g equal 1 teaspoonful).
**lockout-tagout**. IBM field procedures for working safely on a machine that is isolated from its power source and protected from an unauthorized start-up. Lockout-tagout procedures comply with OSHA Standard 29 CFR 1910.147.
**mA**. Milliampere. One thousandth of an ampere (.001 ampere).
**Material Safety Data Sheet (MSDS)**. A form, used in government and industry, that contains chemical safety information.
**Materials of Trade**. Hazardous materials other than hazardous waste, that are carried by a private motor carrier in direct support of a principal business other than transportation by motor vehicle.
**milliampere**. One thousandth of an ampere (.001 ampere).
**molecule**. The smallest part of matter than can exist and still retain the properties of the original substance.
**monochromaticity**. Radiation of a single or small number of wavelengths. For example, laser light consists of only one wavelength of light.
**MSDS**. See *Material Safety Data Sheet*.
**mutation**. A significant and basic alteration; a change in a gene or unit of hereditary material that alters an inheritable characteristic. Most mutations are not beneficial.
**mutagen**. A chemical or physical agent that induces or increases a change in genetic material.
**narcosis**. Sleepiness, stupor or unconsciousness caused by drugs or other chemicals.
**nerve block current**. Electric current of 100 to 200 mA that can damage the nervous system and cause heart stoppage.
**neutral**. A conductor intended to carry current. The neutral provides the current path from the load to the source.
**neutron**. An electrically neutral subatomic particle in the nucleus of an atom.
**nitrile**. A type of rubber that offers a high degree of protection and is reusable. Nitrile rubber is often used for protective gloves.
**National Occupational Injury and Illness Reporting Center (NORC)**. A group within IBM that collects information about injuries and illnesses and determines whether the incident should be reported to a national regulatory agency; it also forwards a report to the appropriate manager and Global Occupational Health Services staff.

**nucleus**. The positively charged central region of an atom that is composed of protons and neutrons.
**ohm**. A unit of electrical measurement that indicates the amount of resistance to electrical current.
**Ohm's Law**. The discovery by the German physicist George Simon Ohm that the voltage in an electrical circuit is equal to the current times the resistance (E = I x R).
**organic solvent**. A liquid that contains carbon atoms and can dissolve another substance.
**OSHA**. Occupational Safety and Health Administration. The federal government agency responsible for workplace safety and health in the United States.
**overcurrent protector or device**. Any device that prevents excessive current flows through inappropriate parts of a circuit. A circuit breaker is one example.
**ozone**. A gas that consists of three atoms of oxygen bonded together in contrast to normal atmospheric oxygen, which consists of two atoms of oxygen. Ozone is an important greenhouse gas found in both the stratosphere and the troposphere. High In the stratosphere, ozone provides a protective layer that shields earth from ultraviolet radiation. Lower to the ground, in the troposphere, ozone combines with other chemicals and gases to form smog.
**Palygorskite**. A hydrated magnesium silicate, which occurs as a fibrous chain-structure mineral in clay deposits in several areas of the world.
**particulate**. Finely divided solid material.
**PCB (polychorinated biphenyl)**. Any of a family of industrial compounds noted primarily as environmental pollutants that accumulate in animal tissue and are responsible for disease and birth defects.
**PELs**. See *Permissible exposure limits*.
**permissible exposure limits (PELs)**. Measurements used by OSHA in the determination of acceptable levels of chemical exposure.
**pH**. A means of expressing the degree of acidity or alkalinity of a solution on a scale of 1 to 14. A pH of 7 is considered neutral; acids have a lower pH, and alkaline solutions have a higher pH.
**phase**. The energized portion of an electrical system.
**polyethylene**. Any of various partially crystalline lightweight thermoplastics that are resistant to chemicals and moisture, have good insulating properties, and are used in packaging and insulation.
**potential difference**. A measure of the energy lost or gained in moving an electron from one point in a circuit to another.
**protons**. Stable, positively charged particles that, along with neutrons, make up the nucleus of an atom.
**PSRB (Product Safety Review Board)**. A group that inspects IBM products and non-IBM logo hardware for compliance with U.S. and international safety standards.
**rescue breathing**. Manually exchanging oxygen and carbon dioxide with a victim who has stopped breathing; also referred to as mouth-to-mouth resuscitation.
**resistance**. The opposition to electric current flow through a medium, substance, or circuit element. The symbol for resistance is R.
**resistor**. An electric circuit element used to provide resistance.
**Right-to-know**. Legislation that addresses the right of employees, customers, and various community organizations to request and receive information about toxic substances that are presented in the workplace.
**route of entry**. The path by which chemicals gain entrance into the body.
**sensitizer**. Substances that cause allergies. See *allergen*.
**solvent**. A liquid capable of dissolving another substance.
**sound wave**. Areas of alternating low and high pressure, which move through air (or any other substance) and, when collected in the ear, are interpreted as sound.
**spasm**. A strong involuntary contraction of a muscle.
**specific gravity**. The ratio of the density of a substance to the density of some other substance (as pure water) taken as a standard when both densities are obtained by weighing in air. A chemical floats on water when its specific gravity in water is less than one and sinks in water when its specific gravity is greater than one.
**SPS**. See *standby power supply*.

**standby power supply (SPS)**. An offline power supply (such as a generator) that is switched online in a power failure.
**star washer**. A washer with “teeth” used to ensure solid connection for proper function of electrical equipment.
**teratogens**. Reproductive toxins that cause physical or mental defects in a developing fetus as a result of exposure of the pregnant female to a chemical at a concentration that has no adverse effect on the expectant mother. See also *fetotoxins*.
**threshold of let-go**. The point at which current prevents you from letting go of the power source during an electric shock.
**threshold limit value**. The airborne concentration of a chemical that a normally healthy person can be exposed to for eight hours a day for a working lifetime without adverse health effects. See also *TLV*.
**threshold of perception**. The point at which the body reacts to electric current.
**threshold of ventricular fibrillation**. The point at which electric current causes ventricular fibrillation. See *ventricular fibrillation*.
**TLVs (threshold limit values)**. Exposure guidelines that the American Conference of Governmental Industrial Hygienists (ACGIH) has established for airborne concentrations of many chemical compounds. The threshold limit is the highest airborne concentration at which it is believed that nearly all workers could be repeatedly exposed day after day without adverse health effects.
**toxic**. Characterized as potentially harmful to the human body because of a chemical response.
**toxicity**. The degree to which a chemical substance is potentially harmful to the human body.
**toxicology**. A science that studies poisons and their effect.
**TTS (temporary threshold shift)**. A temporary loss in hearing sensitivity. Sensitivity may return to normal in a matter of days or hours.
**UEPO**. Unit emergency power off.
**unconsciousness**. A state of not being aware of one's surroundings.
**uninterruptible power supply (UPS)**. An inline power supply (such as batteries) that supplies power when electric power is lost.
**UPS**. See *uninterruptible power supply*.
**ventricular fibrillation**. Erratic or rapid twitching of the heart muscles, causing no blood to be pumped.
**volatile**. A substance that readily vaporizes, such as gasoline.
**volt**. Unit of measure for electrical potential.
**voltage**. A unit of electrical measurement that indicates the potential difference across an electrical circuit. The symbol for voltage is E.